Editorial

TELEVISION is in the radio news this month for two reasons, one direct and one indirect.

The direct reason is the creation by the Government of the Royal Commission on television and the announcement of its personnel. The commission has been asked to return its findings about the middle of this year.

There is probably some difficulty in obtaining the services of suitable people for a commission of this type. This may have some bearing on the fact that while including some admirable citizens, it has not been greeted with very much enthusiasm.

No doubt there is quite a bit which this team can do, and it may be just as competent as any other would be. But there are some aspects of television with which it may have difficulty.

The absence of any technical members places a big responsibility on laymen's shoulders. There is bound to be a good deal of testimony which will require considerable digestion and understanding. There seems no alternative but for the commission to rely upon somebody's advice in technical matters, and it is hard to see on what basis this advice will be accepted or rejected.

There will undoubtedly be great interest in the progress and the outcome of the commission. There will be even more interest in the use made of its findings. By the time these are released we might have some interesting political development to study. As suggested last month, the Labor Party for the moment has sidestepped any showdown on television, but the policy or policies concerning it which might emerge from its changing political status and viewpoint cannot be neglected when looking into the future.

The other point involving television concerns three-dimensional movies. These are films which, by a variety of processes, give depth to pictures as well as length and breadth. If you like, they are stereoscopic.

I do not doubt that this advance, if it is capable of being incorporated in the normal movie theatre as were the talkies, will greatly heighten the impact of movies upon the public, so much so that the picture industry will rely upon it as an immediate answer to television competition. I think its possibilities were realized some little time ago, and its release now, perhaps a little earlier than would otherwise be the case, is designed to give the movie, and if possible all movies, something which for the time being television will not have.

Stereoscopic television isn't impossible—it has been done experimentally for years. In 1936 John Logie Baird told me he could do it in color. But it is highly unlikely that it will come about for many years. Television must have some period now of stability to allow balance sheets to catch up with investments. The unsettling effect following American color experiments should be a warning that further technical complications might have disastrous effects.

In the meantime, you should watch this three-dimensional film. You'll be hearing more about it before long.

John Moyle

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RADIO AND HOBBIES IN AUSTRALIA

A NATIONAL MAGAZINE OF RADIO, HOBBIES AND POPULAR SCIENCE

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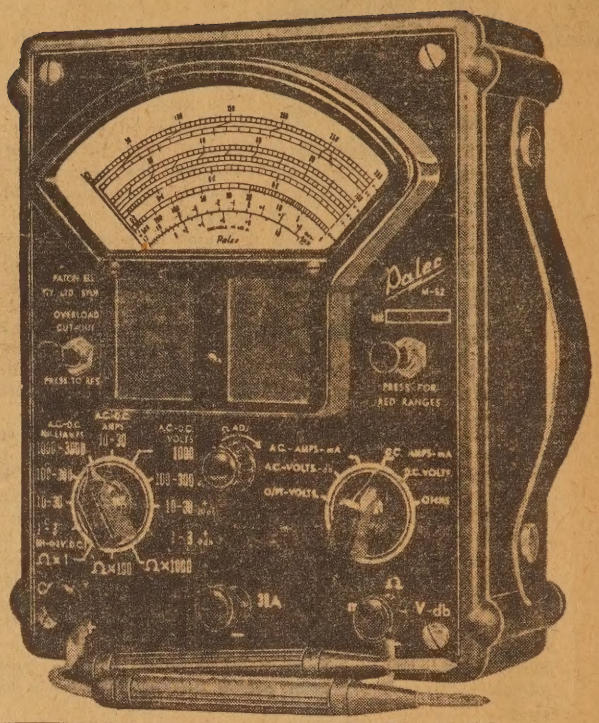

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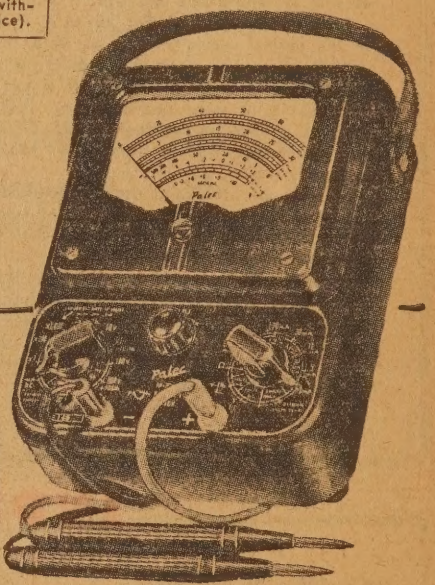

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MICRO-TALKIE FOR U.S. SERVICES

COMMUNICATIONS and Electronics Division of Motorola has announced initial mass production of a hand-sized Handie Micro-Talkie Transmitter designed to operate in the 152-174 Mc. frequency band. The compact unit, weighing only 1lb 13oz, has a power output of 20 to 40 milliwatts and a tested optimum range up to five miles.

Complete transmitter, including self-contained dry batteries and microphone, is contained within a sturdy, seam-welded housing attractively finished with a grey automotive type baked enamel. Overall case dimensions are only 7 3-8in by 2½in by 1⅝in. A rigid, chrome-plated loop antenna doubles as the carrying handle.

To achieve extreme compactness without compromising performance, the tiny transmitter uses eight subminiature tube stages with "printed" associated circuitry.

Operation of the hand-held unit is extremely simple. To transmit it is only necessary to press a button on the side of the unit. With the transmitter operated on the practical duty cycle of 15 seconds out of each five minutes, "A" battery life is one work week, with the "B" batteries lasting two and a half weeks.

There are many applications for this new lightweight miniature transmitter. It is especially useful for patrolmen on foot, watchmen, firemen at the scene of a fire or for on-the-spot news reporting. Industrial uses include railway car checking, inventory control and materials handling, to mention a few.

Chief pilot and instructor, Squadron Leader Ken Robertson (centre) gives the "gen." to helicopter trainees Flight Lieutenant Max McKay (left) and Flying Officers Ron McKimm and Ray Scott (in plane).

HELICOPTERS IN THE OUTBACK

"Anything a horse can do, we can do better." So say members of the RAAF who have flown their helicopters around Australia's outback, doing everything from flood rescue work to mail delivery. A half-day's ride on a horse is a mere twenty-minute flip in the "whirly-bird."

THE conventional plane has already revolutionised life in the country, with fast transport to the cities, delivery of mail and newspapers, swift medical aid and freightage of items ranging from small parcels to farm machinery and livestock.

All this is vitally important, but the usefulness of the aeroplane is limited by two things—its need for smooth landing fields and its inability to hover.

The helicopter knows so such limitations. It can land in any space large enough to hold it. It can hover stationary in the air while it lowers urgently needed supplies or hauls aboard a man awaiting transport.

The type of helicopter at present used by the RAAF can hover or move slowly in any direction, can cruise for 250 odd miles at about 70 mph and carry a thousand pounds of cargo.

The helicopter idea is not by any means new, an elementary type having been flown as early as 1907. However, development was rapidly outstripped by conventional aircraft and the machines did not achieve any real degree of prominence until quite recently—during World War II.

The American Sikorsky helicopter, as used by the RAAF, is among the

Training pilots is a three-month course. Here, instructor directs trainee learning to hover—the most difficult manoeuvre. Most initial "hovers" cover the whole field.

On the job. A skier on top of Mount Buller (5900ft) in the Great Dividing Range, hands pilot Robertson Australia's first helicopter mail for delivery to Mansfield, 20 miles away.

best known of the current types and has already demonstrated just how useful these planes can be.

They might be regarded as belonging to the intermediate or light plane group, most of the military and commercial prototypes now under development being larger and more powerful. They range, in fact, to cumbersome multi-rotor types capable of lifting substantial numbers of troops or heavy pieces of equipment.

At the other end of the scale are the real "light planes," which are envisaged as potential run-abouts for businessmen or family groups. In some of these, the powerful central motor has been dispensed with, the rotor being driven by diminutive jets at the blade tips.

Major use of helicopters overseas has been in rescuing personnel, particularly fliers, who have become stranded in enemy territory. Up till the middle of 1952, US helicopters had been credited with rescuing approximately 6000 Allied fighting personnel in Korea alone.

They are regularly used during large-scale carrier operations to pick up pilots whose planes may dive into the water. Pilots have been rescued in this way from the very path of the speeding carrier.

In this country, the major use of helicopters has been in flood relief and rescue operations, particularly during the winter of 1952.

Less publicised, however, has been the fire-spotting exercises carried out in the Mount Buller to Mount Skene region of Victoria, some of the wildest country in the whole of Australia.

Large-scale survey operations have been carried out also with Victorian Forest Commission Officers aboard. Said Chief Forest Officer Jim Westcott, "You can keep your horses and trucks. A helicopter'll do me."

In point of fact, quite a few years might elapse before the Jim Westcotts of the outback are supplied with helicopters but the trend seems inevitable. Operating from small clearings, they will one day transport medical officers, return the sick to hospital, take over patrol and mail duties, carry passengers to established airline terminals as well as operate emergency relief and rescue services.

The RAAF has proved that they can.

(At right) Like flies around a honey-pot, country youngsters come to look and beg a ride.

(Below) RAAF drops in on a Forestry Commission ranger in the heart of Victoria's wildest mountain region. Trip to nearest town, 20 miles away, takes a half-day on horseback. Helicopter does it in 20 minutes.

The outback's universal "cuppa tea" from a swinging kettle over a log fire in a slab house

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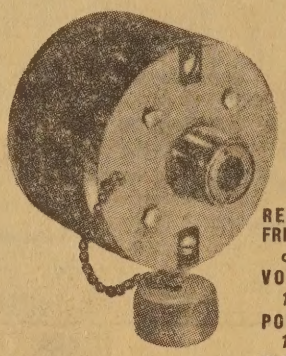

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"PROTOTYPE" PLANES ON WAY OUT

Among the many revolutions in the technique of aircraft construction brought about in the British Aircraft industry in the past decade or more has been a significant move toward "designing for production." Its great importance was shown up recently in the papers read by leading British designers during a conference on aircraft production held at Southampton.

REFERRING to the early days of aviation, one designer told the conference that, "There was a time when the prototype was the designer's pet, surrounded by an atmosphere of mystery. No one must see it, least of all the people who might be called upon to produce it; in fact, it was not the fashion for the production people to be particularly interested in it.

"Prototypes were built in an experimental shop until the aircraft was 'released for production'." He added, "I have known aircraft, even in the days of simplicity, which took a good deal longer to 'productionise' than they took to draw experimentally."

Those were the days when aircraft design was not such an exacting science as it is today and much of the design work was actually done on the job itself, not the drawing-board.

It was usually not until after the prototype had flown that production drawings were begun, and, sometimes, on the larger aircraft, pieces had to be broken down into manageable-sized components, which often meant redesigning them.

The present-day prototype is built in a very different atmosphere. All speakers at the conference were unanimous in explaining how, today, British constructors planned and designed their aircraft for production from the start.

"The production engineers must be consulted by the designers at the earliest possible stage," said one expert.

PRODUCTION WITH DESIGN

"In my company, we locate several senior production engineers in the various sections of the design office to give practical advice in the early scheming stages of the aircraft."

Why has it become so vitally necessary to close the gap between the prototype and the production line? The main answer is the increasing complexity of all modern aircraft, both service and civil, and the consequent necessity to economise in skilled labor and man-hours on the job if the aircraft are to be produced in reasonable time.

The complex modern aircraft has perhaps ten times the potential man-hours in it of the older type, and it would take four to five years to get from prototype to production line if techniques had not been revolutionised.

"Of course, complexity is something we cannot escape from," said a leading designer of fighter aircraft. "It is part of the increasing complexity of life itself in the grip of scientific progress."

Yet this complexity must be controlled right from the start—it cannot be left to accumulate as the aircraft gets nearer and nearer its final form.

The designer of the *Javelin* delta fighter illustrated the trend toward design for production by saying that it was his company's policy to build prototypes not behind the iron curtain of the experimental department, but in the production shops themselves.

This technique has "well justified itself in every respect," he said. "It has laid a foundation for production without in any way sacrificing the prime requirement of a prototype—that is, getting it in the air as quickly as possible."

For some years now, designers have built non-flying prototypes which are twisted and "tortured" in a ground testing by applying all the strains and loads which a real airliner is likely to meet in the worst thunderstorm—all with the object of cutting the time taken on prototype air tests to the minimum, as well as producing a structurally safe and sound aeroplane.

NON-FLYING TESTS

A new extension of this method was described by a speaker at the conference. Known as the "functional mock-up," it has been used to speed tests on the *Britannia* turboprop airliner.

The functional mock-up is virtually a non-flying prototype, built to check all the services — electrics, hydraulics, &c., while still on the ground.

Various tests are made, including tilting the mock-up at the angle at which the actual aircraft may be flown, to see that the services are functioning correctly.

And the functional mock-up continues to be used long after the production line is under way. Modifications, trial installations, new suggestions and revised ideas are assessed on it before they are incorporated in the production work.

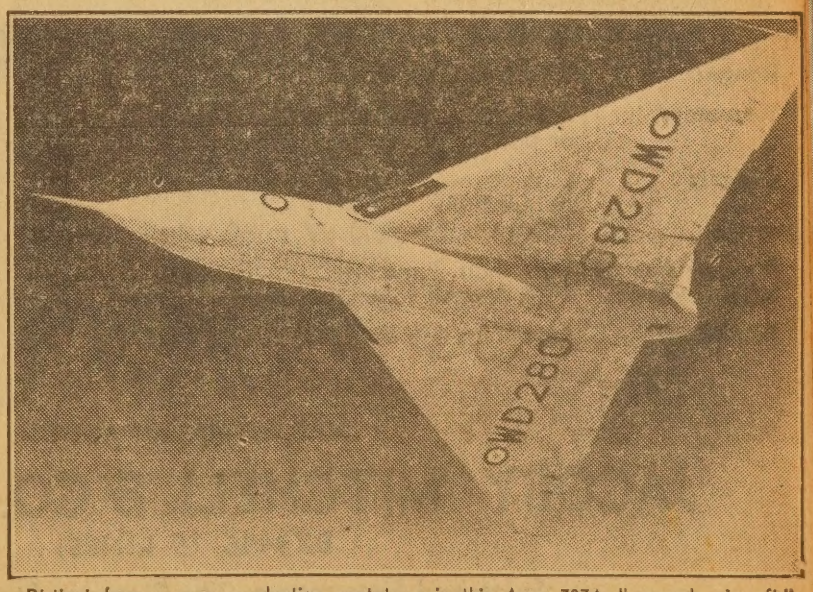
FINANCIAL RISK

Because of the high cost of modern aircraft, a heavy financial risk is involved in this planned production, though naturally the rewards of enterprise are proportionally bigger.

A director of de Havillands described how, in the case of the *Comet*, it was decided from the onset to allocate a sum of money running into seven figures, for advance tooling and procurement of material and equipment. This risk was taken by private enterprise—not a Government department.

Such forward planning might cost the compnay a large sum, "but in our experience," he said, "the risk has always been worthwhile." It had, for instance, been necessary to modify parts of the *Comet* at a cost to the firm of some £350,000, but if this had not been done, it would have meant literally no *Comets* today."

The same speaker made another point—that production must go along with the provision of spares.



Distinct from a pure production prototype is this Avro 707A "research aircraft." Built primarily to investigate high speed flight, the 707A has completed many successful test flights and demonstrated, among other things, the superiority of the delta-wing design. Performance details are still secret, though the plane is known to be powered by a single Derwent engine.

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TRANSISTORS ARE NOT READY YET

Though the newspapers have carried numerous and sometimes extravagant stories about transistors, they are still not yet out of the initial laboratory development stage. They are, in fact, just the spearhead of a vast research programme into the new and unfamiliar field of semi-conductors.

By M. E. KARNS*

LIMITED use of semiconductor elements and devices is as old as radio, of course, but until recently there had been little technical progress in this art. Within the past few years interest in semiconductors, including transistors, has become very great.

The first transistor was announced only four years ago. During this short period the acceleration of engineering effort has been unusual. Important progress has been made in learning the fundamental theory of operation of transistor devices and in establishing control of their operating characteristics and construction processes.

Experimental results already obtained in the laboratories indicate the practicability and usefulness of transistors. There appear to be a number of fields in which transistors will be used widely and to great advantage.

The development of the transistor will make possible new types of electronic equipment which will use not only transistors, but also electron tubes and other electronic components in increasing quantities. The commercial application of transistors appears to be not too distant, although a considerable time is probably required before these units become commercially available on any sizeable scale at low cost.

SMALL SIZE

The intense interest in the transistor may be attributed to the fact that it performs functions similar to those of electron tubes. The transistor is of particular interest to equipment designers who see many circuit possibilities in its characteristics. It is small in size and the power requirements for its operation are extremely low.

When suitable circuits are developed, space and power requirements for complex electronic equipment may be simplified to a large degree by the use of transistors. Another promising feature is that the operating life of certain types of transistors shows indications of being very long, thus minimising replacement problems.

The physical ruggedness of the transistor offers other obvious advantages. In addition, the transistor requires no "warm up" time, but will operate instantaneously upon application of voltage to its electrodes.

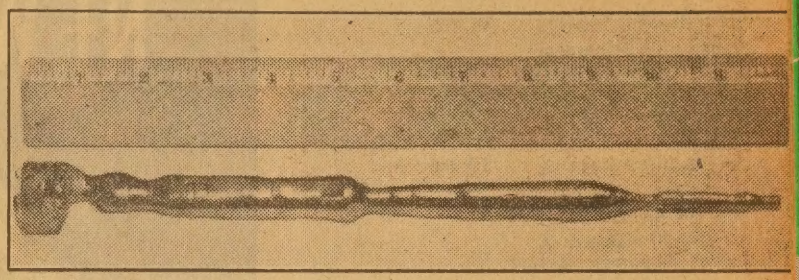
It is anticipated that transistors will be improved in many other respects.

At present, transistors will operate at frequencies up to a few hundred megacycles, but the noise at low frequencies is greater than that of electron tubes. Besides, the power output is relatively low.

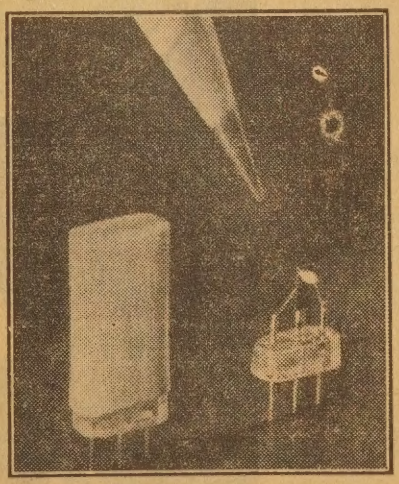
Nevertheless, when the favorable characteristics of the transistor are weighed against its limitations, it appears that this device, even in its present developmental stage, is destined for many applications. The anticipated improvements in characteristics undoubtedly will create new and expanding fields of use.

At the same time, the principles of semiconduction in solids may be expected to play an increasing part in the development of many new electronic devices of which the present transistor is but the first.

There are two types of transistors of major interest at this time—the point-contact type and the junction type. The point-contact transistor was developed first and has performed at higher frequencies. In many applications, however, the junction transistor promises to be as important as the point-contact type. In comparison with point-contact transistors, the junction types have lower noise, higher power gain, greater efficiency, and higher power-handling capabilities but at present are more limited in frequency response.



Part of a single germanium crystal "grown" from a crystal seed. As many as 7,000 transistors can be obtained from the crystal shown, here against a 12-inch rule.



Development junction-type transistor before and after embedment in plastic container, shown here in comparison with pencil point.

At first, the frequency response of the point-contact transistor appeared to be limited to frequencies in the neighborhood of 4 or 5 megacycles. Recently such transistors have been made to oscillate as high as 30 megacycles. Currently, the simple junction transistor has been made to amplify up to several megacycles and the limits are being rapidly raised.

HEAT PROBLEM

The power capabilities of either the point-contact or the junction transistors depend largely on the rate at which heat can be removed from the active portion. There are no basic limitations imposed by the electronic principles of transistor devices which will prevent the attainment of high powers. With relatively simple special cooling means, particularly with the junction types, it is possible to design units with outputs up to one watt or more.

The life expectancy of transistors is largely dependent on electrical and physical considerations. Realisations of tens of thousands of hours does not seem unlikely in normal operation. Transistors can be physically rugged. They can be made practically impervious to moisture and the elements.

Resin-embedded units have withstood impact acceleration of 1900 times gravity and centrifugal acceleration of 31,000 times gravity.

(Continued on Page 91)

** Manager, Technical Services, Commercial Dept., Radio Corp. of America.*

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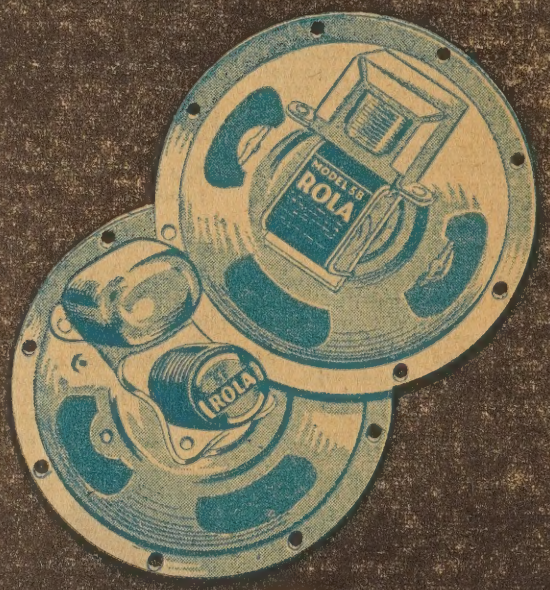
MODEL 5F

Power Handling Capacity	3 watts.
Fundamental Diaphragm Resonance (F91)	175 c.p.s. ± 5 c.p.s.
Frequency Responce	170 c.p.s. — 6.5 k.c.
Voice Coil Impedance	3.5 ohms at 400 c.p.s.
Principal Dimensions :	
Overall diameter of diaphram housing	5"
Diameter of baffle opening	4"
Diameter of voice coil	5/8"
Depth from pad ring to rear	2-1/4"
Mounting :	
Eight holes each 13/64" equally spaced on 4-11/16" pitch circle diameter.	

For further particulars and details of transformer codes see Rola Technical Bulletin No. 12. Available from Rola distributors in all States.

Two NEW



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SPORT — THE ELECTRONIC WAY

Though not all of us may have stopped to think about it, our familiar sports are daily becoming more subject to scientific control. Electrical timing, photofinishes, medical analysis of competitors are just a few examples. You can rest assured that the process will continue, perhaps to extreme lengths.

By Professor A. M. LOW

YES, sport will inevitably become more scientifically technical, more mechanised and less a matter of chance.

The camera, now extensively used for deciding the winner of a race, will be brought into use for giving decisions in other sports where it is considered that the human eye is too easily deceived.

It is now possible to produce a photograph that can be examined in a matter of seconds from the finish of a race, and the future rules for football or boxing may demand that a continuous photographic record is made of the contest so that any decision which is challenged can be decided by the camera.

SMALL MARGINS

Once it is admitted that it is important to avoid an error in placing men an inch apart at the end of a race, it is essential to decide whether they started at the same moment.

The present method of starting is nearly as crude as the old method of timing. We may see "starting blocks" in which the runner's heels are electrically locked until the starting gun is fired so that any possibility of "beating the gun" is avoided.

Already, there are miniature attachments for players and runners who can receive instructions while an event is in progress.

In boxing an electrical machine could register those blows struck below the belt which cause so many disputes. There would be no difficulty in producing such a device and it would not encumber the boxers.

Professional boxing is a sometimes dangerous sport against which educated people will probably revolt. It will be quite simple for scientists to save the sport from extinction and make it much more dependent upon skill.

COUNT THE BLOWS

The boxers will have to wear special light clothing in which electrical contacts will be concealed. Every blow received will be registered and will be flashed to a board so that the spectators can follow the progress of the fight.

Thus boxing will follow the development of fencing which, from an art concerned with running an opponent through in battle or a duel, has become a blameless sport in which recording methods are becoming quite popular.

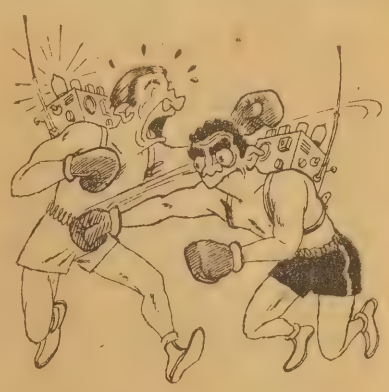
Radar-type apparatus may one day come to be used for controlling ball games. It would not be difficult to provide an invisible "net" that would decide whether a ball in baseball was good or not.

To what lengths the glorification of professional sport will be carried is difficult to forecast. Rapid transport makes it possible to consider "world championships." The tendency is toward a world league.

In the last few decades there has been an enormous increase of public interest in motor-racing of various kinds, a sport which is "useful" in a way that cricket and football could never be.

Many of the major improvements in cars and motor-cycles, such as supercharging, overhead valves and improved fuels, have come as a result of racing and record-breaking. The success of a dirt-track rider depends to some extent on his skill in preparing his machine as well as his skill in handling it. In the near future we may expect developments of great interest by such things as the use of rockets to gain rapid acceleration in all kinds of motor-racing.

"Speeding up" is only another



phrase for civilisation and we are observing its effects even in the more conservative sports, such as fishing where "radar" has been used to detect fish. Deep-sea fishing has been conducted with radio attachments to a harpooned fish and there seems no reason why such an apparatus should not be attached to a fox.

It is, perhaps, a pity that the tradition of "working sport" has almost died out. Covent Garden porters used to test their skill in carrying baskets; Paris waiters, their speed and sense of balance in racing with loaded trays. Tree-felling has become an established sport in Australia and log-rolling is popular in Canada.

There are great possibilities for the development of more mechanised sports in connection with industry. We may yet see competitions between giant grabs removing a p of debris.

It is plain from the crowds "rubbernecks" who watch "men work" that this kind of thing has certain spectacular appeal and it i the advantage over older sports that it is useful. As in motor-ra ing, manufacturers would be stim lated to produce faster, more relia and more efficient machines.

Or we may see races betwe radio-controlled planes in whi there will be a test not only mechanism but of the skill of t controllers. The development such sports seems to be foreshadow by the extreme interest of t younger generation in such thin as powered aircraft models. You men would take more readily to t sport of kings if the electronic jock became fashionable.

FLOORBOARD JIVE

Human beings are less and le inclined to physical effort and it h been said that one day a danc will expect to stand still while t floor does the work. All motio we shall be told, is relative.

It is very much more useful ar sensible to engage in sports whi stimulate quality and research th can be applied in industry. Scienc has contributed a great deal to a sports.

Tennis balls are now kept in re frigerators so that they will hav uniform bounce. Footballs are teste for their bounce by ingenio machines instead of by the nake eye. New methods of making go balls have been devised which mak them travel farther and truer.

Even fishing reels have been im proved so that errors on the pa of the angler do not result in over running or breakage. In the not distant future we may see the sam urge applied to sports derived fro more productive industry.

MANY EXAMPLES

There are many precedents. Th bullfight, and, more recently, th rodeo, evolved from purely utili tarian practices into pure "sports." Early aviation was greatly stimu lated by the sporting element; th development of the aircraft for mili tary and commercial purposes cam much later. Without the early race and meetings the aeroplane migh have remained for many years a a clumsy and useless affair of "bam boo and string."

We are approaching the time wher the majority of human beings wil belong to the "idle classes." It wil be a tragedy indeed if, science hav ing provided the leisure, men and women can find no better use for it than a search for forgetfulness (from What's The World Coming To).

he forgeries done by van Meegeren, who died recently, were so good that he had o go to considerable lengths to prove himself the forger. Here, under police upervision, he is shown painting "Christ In The Temple," after the Vermeer pattern.

WHAT ALL FORGERS MUST KNOW

The art of painting is closely bound up with various branches of science from the chemistry which is responsible for the pigments used by the painter to the methods used to authenticate an old picture or to detect a forgery.

by Calvin Walters

MOST of us would like to be able to draw pictures. When we were kids there were not many of us who didn't like to draw pictures over everything within range of our chalks and crayons.

I don't remember much about my toddler days, but somewhere in the family relic chest are authentic examples of my work. I believe there is a family Bible upon the vacant spaces of which are representations of my relations' features and drawings of pet animals. These, of course, were done in the moments when my father wasn't looking.

LIMITED VALUE

I am told that the drawings are not good, although done in such a good book. Today, however, they could perhaps take their place in a futuristic art show, because that's childish enough for anyone. The only thing I can draw now is my salary and I can do this really well.

Many, however, have developed into first-rate artists. To all such this article should be particularly interesting, for it is well to know something about the materials we use in our work and also to be assured that, if we really become famous, the means are there to cope with those who would forge our work and benefit by our fame.

The art of painting pictures has very remote origins and it is to the ancient Egyptians that credit is given for the first attempts to depict the human form by means of color. Their efforts were very primitive, being merely outlines filled in with flat color. They were not much better than the attempts, perhaps centuries before, of the Australian aboriginal, who drew pictures of kangaroos and so forth on rocks.

There seem to be some descendants of this early race of painters living today. They are in great demand during election campaigns and are employed by political parties to draw derogatory pictures of their political opponents on walls.

The ancient Egyptians used about nine "colors" in all, namely, white, two yellows, two reds, light blue, green, brown and black. The white was pure natural chalk, yellow was a vegetable yellow and also a yellow ochre. Cinnabar (sulphide of mercury) provided the red. The blue was powdered blue glass, which was stained with copper. This, mixed with yellow, provided a green. Black came from charcoal.

With the discovery and use of further kinds of pigments, the art of painting was provided with a further stimulus. The pigments of the early painters were mixed either with some kind of gum or made into a paste with water.

I had a "painter" paint my house recently. I think he was a descendant of these ancient Egyptians, judging by the way the stuff is rubbing off today.

The greatest painters of all were those who entered the field when oil paint was introduced. This came about in the early 15th century and opened a vast field to the artist.

Now, this article is not intended to be a history of painting, but it is beginning so much like it that I had better get on with the main subject, namely, the chemistry of paints. The history of painting is so controversial that I have no wish to get into the argument, thus getting my ankles caned from all directions.

Now, if you remember the colors in your paint box, you will no doubt be acquainted with Chinese Red. This is so-called because it originally came from China. It is a sulphide of mercury and is made by chemically uniting mercury and sulphur. Mercurp and sulphur is ground together and then burnt in a retort. The mixture vaporises and condenses in the cooler part of the tube. The deposit is black but, when ground into a fine powder, it becomes red—hence, Chinese Red or Vermilion.

Sulphide of mercury also occurs naturally and is colored a brick or bright red. This natural substance is called cinnabar and is the ore from which the metallic mercury is obtained.

There are other ways of making this sulphide, which need not be mentioned, as the final results are the same.

Another well-known color is Indian Red. This is a natural product of India, being natural red oxide of iron mixed with a small percentage of black oxide. This gives it the characteristic peculiar purple tint.

YELLOW AND RED

Light Red is also an oxide of iron, the hydrated variety, which also produces yellow ochre. When yellow ochre is heated, the water of hydration is driven off and what is now the anhydrous oxide of iron is red in color and known as light red.

Venetian Red is much prized as a pigment. It is made by treating sulphate of iron with lime. This in solution throws down a dirty grey precipitate which, on being heated, assumes the characteristic red of Venetian Red.

Pure Scarlet, a very beautiful but unstable color, is made by mixing chloride of mercury, a deadly poison, with iodide of potassium. Under correct conditions a pale salmon precipitate is thrown down which, on standing, becomes red, the red of Pure Scarlet.

There are very beautiful colors called "Lakes," which we all know as part of our color boxes. The manufacture of these is an interesting chemical process.

ORGANIC SOURCES

Certain organic matters are naturally colored. For instance, Cochineal is red and comes from a certain kind of bug. The root of a plant called Rubia tinctorum provides Madder, a red coloring matter. Certain berries from Persia are Yellow and so are certain other plants such as the Quercitron.

Now the coloring matter in these plants and insects can be extracted in the following manner. If to a solution of Cochineal, a solution of alum, free from iron, is added, and the solution warmed, a precipitate will be formed and the alumina of the alum will carry down the coloring matter of the Cochineal. The precipitate is called Crimson Lake. Carmine is a lake made from a stronger solution of cochineal.

A Carmine Lake made from Madder is a more complicated process and the resulting pigment is very expensive. For this reason, it is often imitated and many frauds have been carried out.

Gamboge is a yellow powder made from a resin. When dissolved in alcohol, the fine yellow powder can be precipitated out.

"Cadmium Yellow" is made from a salt of the metal cadmium. Sulphuretted hydrogen is passed through the solution and the yellow precipitate is thrown down.

"Chrome Yellow" is made by mixing bichromate of potash with nitrate of lead. The yellow precipitate is Chrome yellow. If some of this is boiled with lime the color becomes Chrome Orange.

SCARCELY A FOOD!

"Emerald Green" is very poisonous. It is made by mixing arsenic with a solution of acetate of copper. The resulting precipitate is Emerald Green.

"Prussian Blue" is a precipitate formed when a solution of sulphate of iron is mixed with one of ferrocyanide of potassium.

"Ultramarine" is of two kinds, namely, natural and artificial. The natural product is made from a mineral called Lapis Lazuli. The stone is crushed, heated and plunged into vinegar. This renders it friable. It is crushed to a fine powder and levigated for a long period in a mixture of honey. It is then made into a paste with resinous matter, wax and linseed oil, and after some days treated with water, which slowly washes the coloring matter out. The ultramarine thus obtained is extremely costly.

Artificial Ultramarine is the product of precipitated silica and alumina acted upon by soda lye. This is mixed with sulphur and heated and after further treatment with different temperatures the mixture turns blue.

White lead is of course well known. It is a carbonate of oxide of lead, but is now rapidly being superseded by "Chinese White," which is nothing more or less than Oxide of Zinc made by burning zinc in a current of air.

Space will not permit of further details of pigment manufacture, but sufficient has been said to indicate the importance of chemistry to the art of painting. It is due to a knowledge of this chemistry, as applied to chemical analysis, that enables the modern art galleries of the world to examine pictures for authenticity and restore damaged pictures to good condition.

RECENT CASE

A recent example of the detection of forgery was the case of the Dutchman Hans van Meegeren. This gentleman was such a good artist that he was able to copy works of famous artists so faithfully that he fooled even the experts. He sold many pictures, which he signed with the names of famous ancient artists, to members of the Nazi Party during World War II.

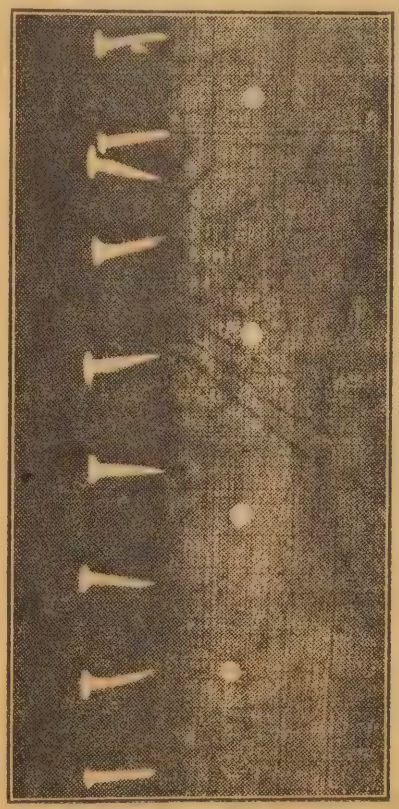
Now van Meegeren knew that the artist Vermeer used only ultramarine made from lapis lazuli in his wo Thereupon the dishonest van boug some from a supposedly reliab source in London. But the sho keeper in London or the person bought the stuff from must ha been doing a spot of fraud himse for the lapis lazuli he sold van Me geren was adulterated with cob blue and the Dutchman went merri along with his painting unaware the adulteration.

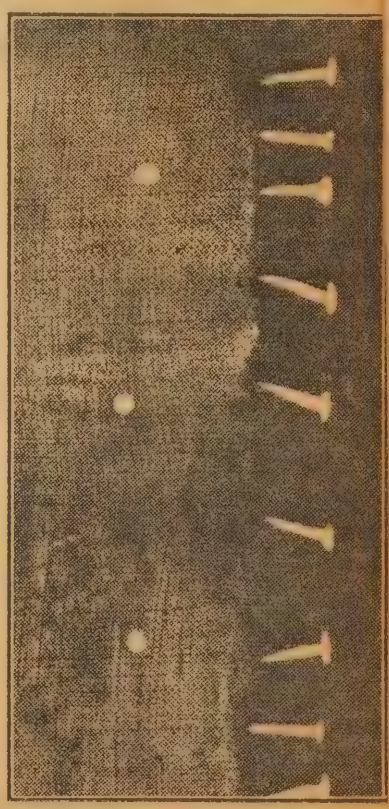
Now the experts always analy the paint in a picture by taking stab with a fine needle in such a wa that the picture is not damage They found cobalt in the suppose Vermeer picture and as cobalt w not used by artists prior to its intr duction in 1800 and as Vermeer die prior to that date, then the suppose Vermeer was not. This circumstanc helped to jail the clever counte feiter van Meegeren.

It is such methods and reasonin that the art sleuth uses. He know just what should be the compositio of the various colors used by artist and knowing the date of the artist' death and the date of the introduc tion of various pigments he ca make a check. Obviously no pictur can have been painted earlier tha the date when a certain color in th picture was first introduced.

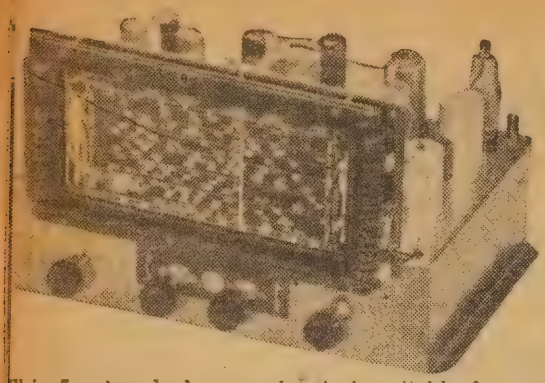
CHEMICAL ANALYSIS

The small samples taken from picture as mentioned above are sub jected to analysis for the detectio of various things. For instance treat ment of the samples with wate





One of the master fools which [illegible] van Meegeren's "Disciples At Emmaus" as a forgery. Original image at left [illegible] Vermeer. Extreme magnification from faulty lens reveals [illegible] of [illegible] the [illegible] details like [illegible] [illegible] [illegible]



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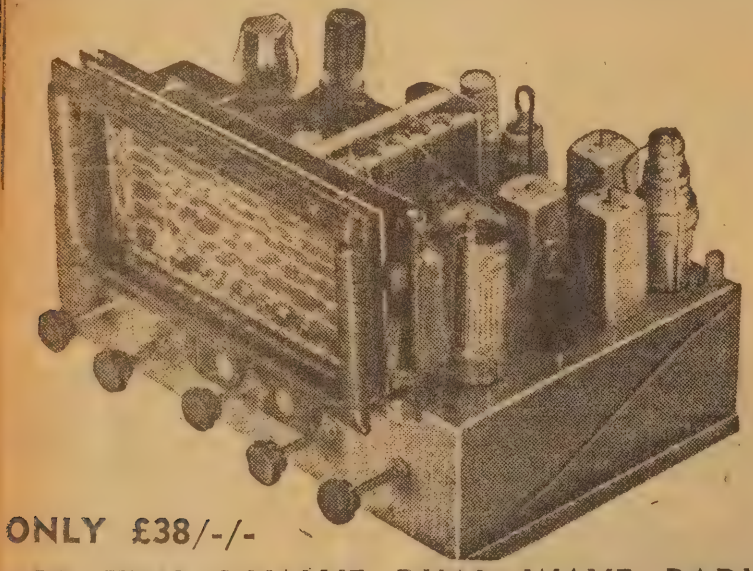

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5 valve with 12" speaker £21/10/- (suitable for phono pick-up only 8 watt output).

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alkalis, various solvents and acids will show whether the artist used oil, protein or carbohydrate with which to mix his colors. It will also enable the pigment itself to be separated and tested for characteristic color, its structure and so on.

The shape and size of the particles in the pigment are examined microscopically and even the refractive index ascertained.

The picture is examined by means of x-rays, ultraviolet light, spectroscopes and other instruments.

The use of x-rays is widespread for it shows great detail. It will give the thickness of paint and its density, an important point when the characteristic methods of a painter are known.

Sometimes a painter may paint a picture and be dissatisfied with it. He will paint over the canvas and do another picture on top of the original one, thus saving canvas. X-rays reveal these things. A forger may buy old paintings of no value merely to acquire a canvas showing all the signs of age. He then paints a counterfeit picture over the old one and treats the surface with special varnish to give the appearance of age.

The aforementioned Hans van Meegeren painted a counterfeit Vermeer over a painting by Hondius but he was found out by the x-ray picture.

ULTRAVIOLET LIGHT

Ultraviolet light will also reveal as much as the x-ray. Radiation of ultraviolet light will reveal alterations by means of the variations in fluorescence of the paint. It will also reveal the chemical composition of pigment.

Microscopic analysis is a useful means of sometimes determining the origin of a painting.

For instance the old Flemish and Dutch master painters used chalk in the white priming coat first put over the canvas. A sample of the priming coat will reveal small marine fossils under the microscope. Similarly examination of a priming coat which reveals that it consists of burned gypsum mixed with glue will indicate that the picture came from either Italy or one of the other Mediterranean countries.

On the other hand if the priming coat was made from the anhydrous variety the picture probably came from a Venetian painter.

Sometimes it is found that someone has repainted portion of a damaged picture in order to restore the value. An ingenious device is in use in large galleries which takes a piece of the paint about one sixty fourth of an inch in diameter and slices it with a special machine into several slices. This exposes the layers of paint and sometimes the boundary of the original and new paint.

The spectroscope is used to detect elements of a pigment which are present in very small quantities.

In addition to the chemical and mechanical means used by art detectives great knowledge is necessary of the methods used by almost every great artist known to art. Some painters paint with broad bold strokes, some with delicate flat paintwork.

It will thus be seen that the modern art gallery is also a scientific laboratory and the forger today has not much chance of getting away with too much for too long.

Technical Review

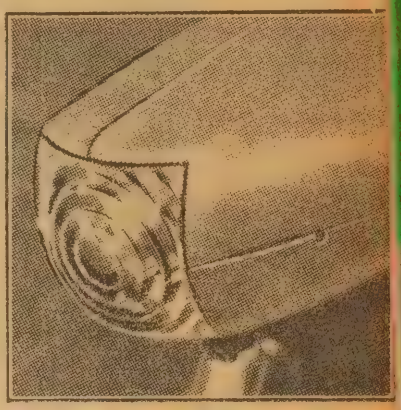
NEW ELECTRONIC EYE AUTOMATICALLY DIPS CAR HEADLAMPS

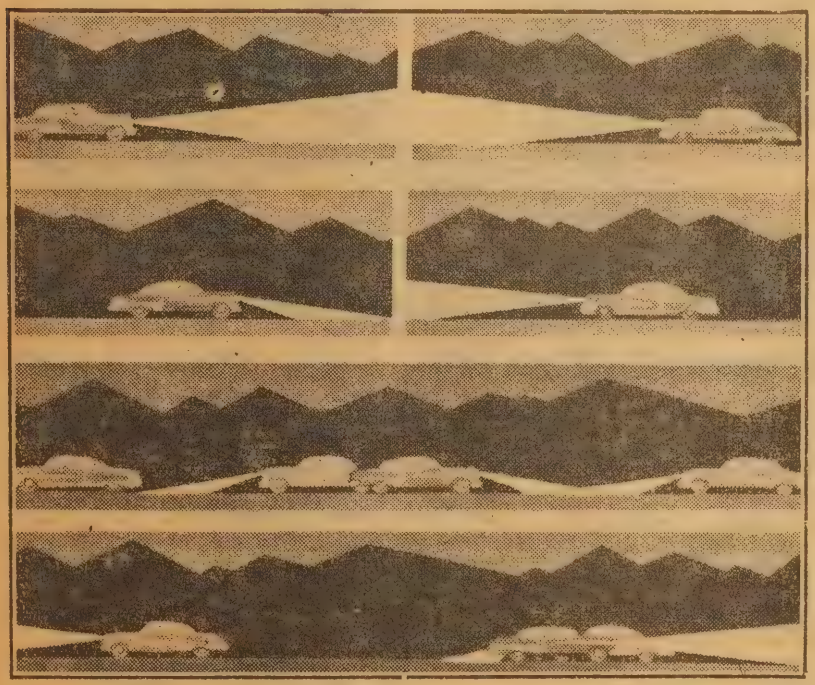
Eye-blinding glare, bane of night drivers and one of the hazards of after-dark travel, has been relieved of some of its danger and some of its tedium by the agency of a small multiplier phototube developed for the job by RCA.

THE new tube, looking like a standard "GT" radio valve, is the key component in the General Motors "Autronic Eye"—trade name for their automatic headlight beam selector.

The phototube is enclosed, together with its relay and control circuits in a small housing, which retracts out of sight during the day. At night, however, mounted behind the windshield of an automobile, the "Eye" sees what the driver sees and electronically selects the headlights of the car on which it is installed, and keeps them dim until the other vehicle or vehicles have passed. Similarly, it dims the headlights when the car enters well-lighted streets, and brightens them when the car enters darkened avenues.

The device is available on several late model automobiles and in due time may become standard equipment on all vehicles because of the greater highway safety and driving comfort it affords.





HOW THE AUTRONIC EYE WORKS

1. Autronic-Eye keeps headlights brigh as long as approaching headlight are beyond the glaring range.

2. Eye automatically shifts headlight from upper to lower beam when oncoming car approaches.

3. Maintains lower beam—even though oncoming lights are depressed—until nearest car and others behind it have passed.

4. Automatically returns headlights to upper beam when all oncoming cars have passed.

the safest headlight beam to suit approaching road conditions. The "Eye" relieves the driver from the responsibility of constantly operating the conventional foot-switch to dim when approaching other cars or entering well-lighted or dark streets and highways.

The phototube is extremely sensitive to light. When it picks up light from approaching traffic, it triggers a control circuit which dims

ORDINARY steel strapping, used to strentghen packing boxes, will cut steel as well as the best toothed saw blades at high speed on a bandsaw. Ordinary bandsaw blades that cost more thn three dollars each and last less than two hours can be replaced by steel box strapping that costs about 10 cents and last up to 29 hours. The new sawing method was discovered at the Solar Aircraft Company, which had been spending several thousand dollars a month for bandsaw blades. It had been thought that teeth were necessary to bring enough oxygen into the cutting area to speed the burning that results from blade friction. Solar discovered that the toothless blades hardened and roughened within a few seconds of use so they scoop at least as much oxygen as the toothed blades.

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DESIGNING A LOW—NOISE AMPLIFIER VALVE

Modern electronic equipment frequently calls for the use of low noise amplifier valves. An article by P. Welch in Electronics explains the various factors a valve engineer has to consider in designing for this requirement.

THREE main sources of tube noise are microphony, hum and hiss. Besides limitation of these noises, the tube must be capable of reasonably high gain because if the first stage amplification is not enough, noise from the second tube becomes appreciable.

The 6BR7 has been designed with low noise requirements in mind. The high gain required limited the choice of tube type to a pentode although this structure does introduce certain undesirable noise features.

The most natural choice of existing characteristics was that of type 6J7 and in order that the 6BR7 should be fully equivalent it was designed with a low anode-to-grid capacitance.

The tube is of the nine-pin miniature type.

Use of the nine-pin miniature construction allowed the tube elements to be mounted close to the glass base. This lowered the centre of gravity, as compared with an octal-based type, and it was less prone to movement under conditions of vibration.

In the design of the 6BR7, the size and shape of each electrode was chosen so that it should not have a low frequency fundamental resonance. This insured that the vibration of the element should not give rise to regenerative feedback at low values of gain. This effect is usually the limiting factor to tube performance and every effort was made to effect improvements over previous designs.

SHORT STRUCTURE

In order that the general resonance value should be of relatively high frequency and low amplitude, the structural length of the tube was kept as short as possible. Individual electrodes were then studied in turn.

To prevent movement, the cathode of the 6BR7 was locked in the insulating member. This was done by making a small bead in the round wall of the cathode, inserting it through the insulator and then clamping the end together on the other side of the insulator. (Fig. 1.)

The grids of the 6BR7 were made with either a keyhole or an oval type of profile (Fig. 2). This was done so that the grid wires could expand during the heating associated with tube manufacture and yet return to their original shape when cool.

It was not necessary therefore to provide expansion slots in the insulators for the supporting members, which could then be held by very tight fitting holes.

The most serious cause of grid movement was found to be the resonance of the supporting member itself. Figure 3 shows a conventional insulator and grid assembly. It can be seen that the grid supporting

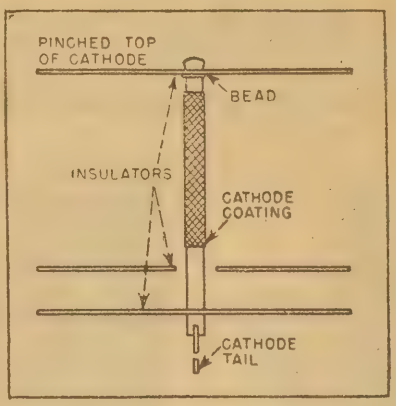

Fig. 1. Means for locking cathode.

member will behave similarly to a beam supported at two points. If the beam could be clamped at either end the frequency of resonance would increase and the amplitude for a given accelerating force would be less.

The 6BR7 incorporates a double-insulator system at each end with the two insulators separated by small distance, Figure 4. This construction achieves the results clamping at both ends and yet allow the grid-supporting member to expand.

Experiments showed that the fundamental resonance of the suppressor grid could be increased from 700 to 1700 cps with a decrease of noise output under conditions of constant acceleration of about 10 to 1. This construction was applied to all the grids except the control grid.

In this case the grid was clamped at the top end but the connecting member to the stem wire at the bottom and achieved the same results.

As a further feature in structural design the four insulators of the 6BR7 were held by four wires which passed through holes near the periphery. The shielding members were all welded to these wires insuring that the insulators were all firmly held.

The anode of the 6BR7 was designed to reduce vibration. Besides the usual strengthening ribs it was supported between the insulators in three places preventing movement in any direction, Fig. 5.

Finally the tube assembly was located in the glass bulb very tightly

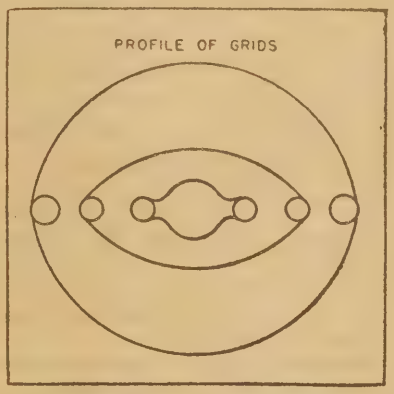

Fig. 2. Grid profile for 6BR7

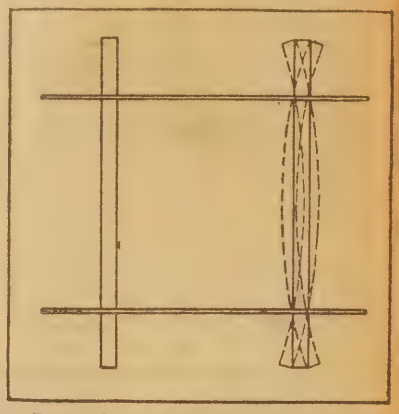

Fig. 3. Conventional insulator and grid.

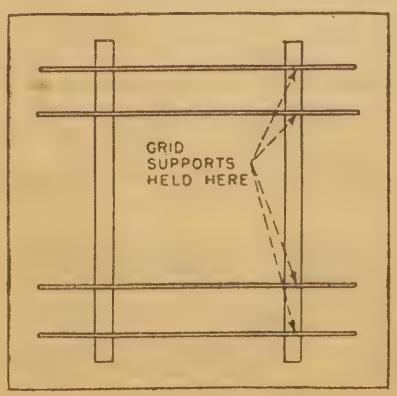

Fig. 4. Double-insulator system.

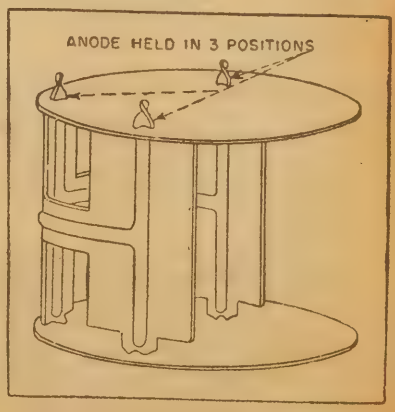

Fig 5. Means for securing anode.

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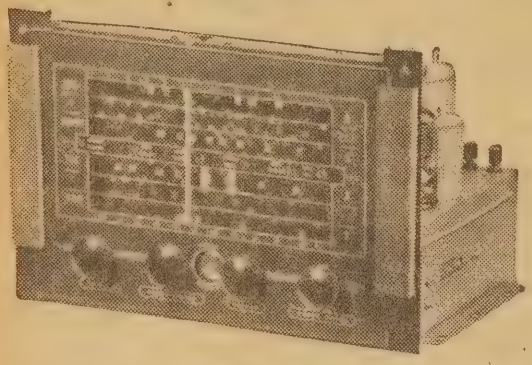

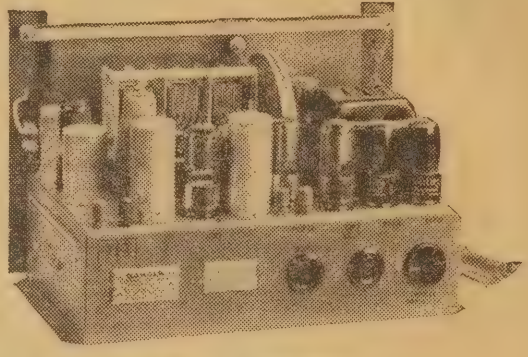

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by virtue of the four-insulator construction. This is important because as a rule the glass bulbs are of irregular internal diameter and a structure which is held by two insulators cannot always accommodate these variations.

Hum is caused by the a-c heating of the cathode. It may be due to the capacitance between heater and grid, the induction effect between heater and grid, the magnetic effect, heater emission and/or by poor insulation between heater and cathode.

Insulation hum is rarely serious with the modern techniques of heater coating and in any case its effects can be largely countered by the

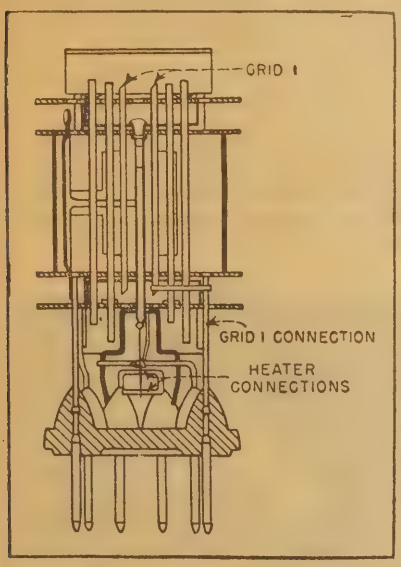

Fig. 6. Section of tube showing shielding (heavy lines) to reduce grid-to-heater capacity.

cathode by-pass capacitor used in the circuit.

Magnetic hum is always met when faggot-type heaters are used and it may be almost completely avoided by using a double helical heater with a low heater rating because in such a heater design the return helix balances out the magnetic effect of the first helix. The 6BR7 uses a heater of this type with a rating of 6.3 volts at 0.15 ampere.

The static hum, caused by the capacitive effect and induction hum may be reduced by suitable screening between grid and heater. The more serious of these two is that due to the capacitive effect. The 6BR7 incorporates shielding devices so that the capacitance between grid and heater within the tube envelope is practically zero (Fig. 6).

CAPACITY IN BASE

The disadvantage of the single-ended tube is apparent, as there must always be a capacitance effect in the glass base. Experiments show that nearly all of the hum produced in the 6BR7 is due to this.

Lastly the conduction effect due to heater emission is non-existent since the cathode is pinched at the top and the heater shielded at the bottom (Fig. 6).

Hiss noise due to electron emission is of a fundamental nature. The effect can be aggravated, however, if there are gas molecules present within the tube. These will ionize and change the nature of the space current. In the manufacture of the 6BR7, every effort is made to produce a tube with a very good vacuum.

Surface texture of the cathode coating, in extreme cases, is also responsible for noise effects. If the emission is limited to isolated patches, the motion of the electrons becomes sporadic. By insuring that all the cathodes have a smooth coating and that the processing involved in manufacture is closely controlled, this trouble has been avoided in the 6BR7.

Finally, the insulators of the 6BR7 are all coated with a preparation that insures a very high resistance between electrodes. This is essential because the tube is normally used with a very high grid resistor which would produce a noise voltage at the grid if the leakage current were high.

A NEW TYPE OF METAL RECTIFIER

A new type of rectifier recently developed by the U.S. National Bureau of Standards promises to be the first major improvement in metal-oxide rectifiers since their introduction in 1926. The new rectifier is composed of a layer of semi-conducting titanium dioxide, a sheet of titanium metal, and a counter electrode of some other conducting metal.

ALTHOUGH the development is still in an early stage, preliminary investigations have shown that the units withstand voltage in the reverse direction reasonably well and that their properties are satisfactory at elevated temperatures. Both the initial development and subsequent detailed exploratory investigations are the work of R. G. Breckenridge and W. R. Hosler of the NBS Solid State Physics Laboratory.

The earliest practical type of metallic rectifier was the copper-cuprous oxide rectifier, invented in 1926 by Grandahl, which consists of a copper sheet covered with a layer of cuprous oxide, and a counterelectrode on top of the oxide layer.

WIDE RESEARCH

Many extensive investigations have been undertaken to develop similar rectifiers, but until now no other metal-oxide film combinations have been found that were feasible, although several non-oxide types have been produced—e.g., the selenium and magnesium-copper sulphide rectifier.

The new NBS rectifiers are prepared by forming a layer of titanium dioxide on a sheet of titanium metal and then applying a counterelectrode to the oxide surface.

Two processes have been devised to form the oxide layer. The first process involves heating the titanium metal first in oxygen gas and then in hydrogen gas. The other—an improved version of the first—consists in heating the titanium metal in steam at elevated temperatures.

In the first process, ½in squares of commercial titanium metal sheet, 0.020in thick, are polished and heated in oxygen gas to form the coat of titanium dioxide. A thin, tightly adherent coat of oxide is obtained after a treatment at 800 deg C for about two hours.

The oxide layer formed in this manner becomes a very poor conductor of electricity; it is made into a semi-conductor with a much greater conductivity by heating in hydrogen gas, which causes a loss of oxygen. A study of the reaction showed that heating in one atmosphere of hydrogen at 500 deg C for 15 minutes would produce sufficient conductivity.

After the hydrogen treatment, a counterelectrode is electroplated on the desired rectifying surface of the oxide by a-c plating techniques. A number of metals have been tried successfully as counterelectrodes, including silver, gold, tin, nickel, copper, zinc and cadmium, although silver has been used for the majority of the work.

When the current is measured for various applied voltages, it is found to flow much more readily in one direction than the other; hence, the combination acts as a rectifier.

Rectifiers produced by this process are electrically satisfactory; however, the two-step process is difficult to control and, in addition, the oxygen and hydrogen gas tends to dissolve in the heated titanium metal and make it brittle.

The second process of oxide formation, using water vapor, produces the semiconducting oxide layer on the metallic titanium in one step. The most satisfactory films are formed by heating similar titanium plates in steam at 600 deg C for about three hours. The counterelectrodes are then electroplated as before to form a finished unit.

This process produces a rectifier with improved electrical properties and lacks the undesirable embrittlement accompanying the other method.

While the titanium-dioxide rectifiers are still in a very early stage of development, some of their properties have aroused considerable interest. The units can withstand a reverse voltage of about 20 volts per plate. In addition, they have good properties at elevated temperatures; their performance is actually improved with increasing temperature up to about 150 deg C.. Detailed studies have not been made of their operating life, but tests thus far are very encouraging.

CURRENT FLOW

The NBS titanium dioxide rectifiers bear a physical resemblance to the copper oxide type; however, there are fundamental differences between them. For example, the direction of easy flow current is opposite in the two types. In the titanium dioxide rectifier, the electrons flow from the titanium metal base plate to the counterelectrode.

The mechanism of conduction in the metal oxides is also different. In cuprous oxide the charge carriers are "holes" or electron vacancies in the lattice, while in titanium dioxide semiconductors the charge carriers are free electrons.

Finally, the "barrier layer," or asymmetrical potential that must be surmounted by the charge carriers, apparently is located near the counterelectrode-oxide interface.

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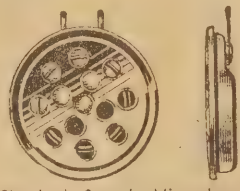

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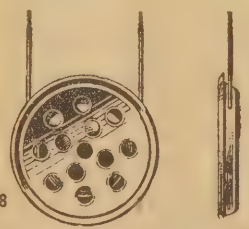

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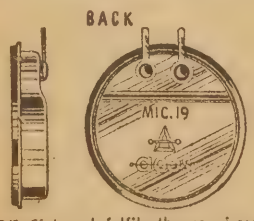

MIC 19/2 Sintercel fulfils the requirements for a flat insert with good sensitivity and a frequency response 40/8000 c/s. Unaffected by vibration, exceptionally robust construction. PRICE, £2/19/9.

The Acos GP30 turnover head type pick-up is fitted with two separate sapphire styli, one for standard and one for microgroove records, either of which can be placed into operating position by a simple turn of a knob at the front end of the pick-up arm. The knob is clearly marked to show which stylus is ready for use.

Cartridges (for GP.20 standard) GP.19.	£2/19/9.
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Cartridges (for GP.10 standard) GP.9.	£1/11/6.

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NEWS AND VIEWS OF THE MONTH

D.M.E for ocean flights

AUSTRALIAN developed Distance Measuring Equipment for aircraft is now in use for the first time on ocean flights between Australia and South Africa. DME, as it is known, indicates to the pilot the code letters of ground radio beacons which guide him on his course, and the number of miles he is distant from them. It does this visually with no special skill or time loss on his part.

The equipment operates on general radar principles in that it measures the time taken for a signal to travel from the beacon to the aircraft when triggered by a transmitter in the aircraft itself. Each beacon transmits a coded identification which the aircraft's receiver translates into call letters visible on the instrument board.

Out of CERCA (Commonwealth and Empire, Radio Civil Aviation) and ICAO (International Civil Aviation Organisation) Conferences at the close of World War II came the new safeguards for flight.

Among the members of one of ICAO's early sub-committees was youthful and energetic Dr. E. G. Bowen, a member of the Australian delegation whose work in the wartime "backrooms" of Britain ranked him among their leading physicists.

He returned to Australia, where he directed the work of the radio physics branch of the Australian Commonwealth Scientific and Industrial Research Organisation (CSIRO). He summed up the task:

"Can we, from the mass of wartime radio aids . . . devise for international flight a means of telling a single pilot, from a glance at a dial, his exact distance at any time from a known point, yet fully automatic in its operation and contained in a box no more than 40lb in weight?"

And within twelve months the job was completed and laboratory models of Australia's DME were ready for tests. It was done by the radio physics laboratories of CSIRO in co-operation with research engineers of AWA, which is now manufacturing DME for installation throughout Australasia.

DME has achieved all that those early conferences had asked of it. Fifty-one nations have reviewed its performances and 50 have voted for its acceptance for international usage by the world's airlines in its present form.

The United States, however, has given domestic reasons for not accepting the equipment for international usage. The United States asked that the equipment — now operating in the 200 megacycles band —be redesigned to operate in the 1000 megacycles band. This created a controversy that is still current among research men throughout the world. In the meantime, DME is on the job of protecting lives in the air.

New diving chamber

THE National Geographic Society is using a new strange diving chamber called the "aquascope" off Florida Keys for experiments in underwater color photography at night.

The "aquascope" or "waterlooker" is a 2700lb tank, built of armor-plate steel with wide plastic windows. It carries two men, with color cameras, high voltage power equipment, and high speed lights 50 to 100ft down.

Lying on an air mattress inside the aquascope, cameramen photograph undersea life in natural-color film. They can stay down indefinitely, watching fishes and other creatures of the reefs and shoals in all their normal activities.

Split-second flashes of the powerful lights are not expected to disturb marine life "sitting" for portraits.

Nor will the presence of the men inside the chamber be obvious, since all outgoing air is returned to the surface by air hose rather than released as bubbles.

As far as is known, this equipment is the first ever designed especially for photographing underwater life.

The society's tests are being supervised by Gilbert Klingel, designer and builder of the aquascope. Its photographer, Willard Culver, accompanies Klingel on dives of the aquascope.

The aquascope is a flat, ribbed

POPULAR SCIENCE QUIZ

Q. How does a waterbag keep water cool?

A. Water seeps through the canvas bag and evaporates from the outside surface. Heat is required for water to change its state from the liquid to vapor. This heat is taken from the water in the bag, causing its temperature to fall until a steady state is reached where the quantity of heat taken from the water to evaporate that which seeps through to the outer surface is equal to the heat received from the surroundings due to the temperature difference between the water in the bag and the surroundings.

On a hot, muggy day when the relative humidity is high, the evaporation is slow and the water in the bag will be only slightly cooler than the surroundings, probably of the order of five degrees.

In contrast, on a hot dry day when the relative humidity is low, the rate of evaporation is higher and the water is considerably cooler than the surroundings, probably of the order of 20 degrees.

Thus the more rapidly the water evaporates, the greater the temperature difference between the water and the surroundings. In general, therefore, the bag should be placed in a current of air in the shade.

The familiar "Coolgardie safe" operates on this principle.

Q. Why does the pitch of a train whistle or car horn change as the vehicle moves toward or away from an observer?

A. This is known as the "Doppler effect" and its interpretation by mathematical treatment is based on Doppler's Principle. In its treatment, the velocity, wavelength, frequency and period of the sound wave are taken into consideration.

When the vehicle is moving, the wavelength is changed but the velocity remains the same. When the observer only is moving, such as when one car is passing a stationary car the horn of which is being sounded, the velocity of the sound wave will appear to have changed although the wavelength remains unchanged. Thirdly, when both the source and observer are moving, the wavelength changes and the velocity appears to have changed. All velocities are taken as being in one direction.

Thus the pitch of the note from a horn or whistle will be raised if the vehicle or train is moving toward an observer and will be lowered if moving away.

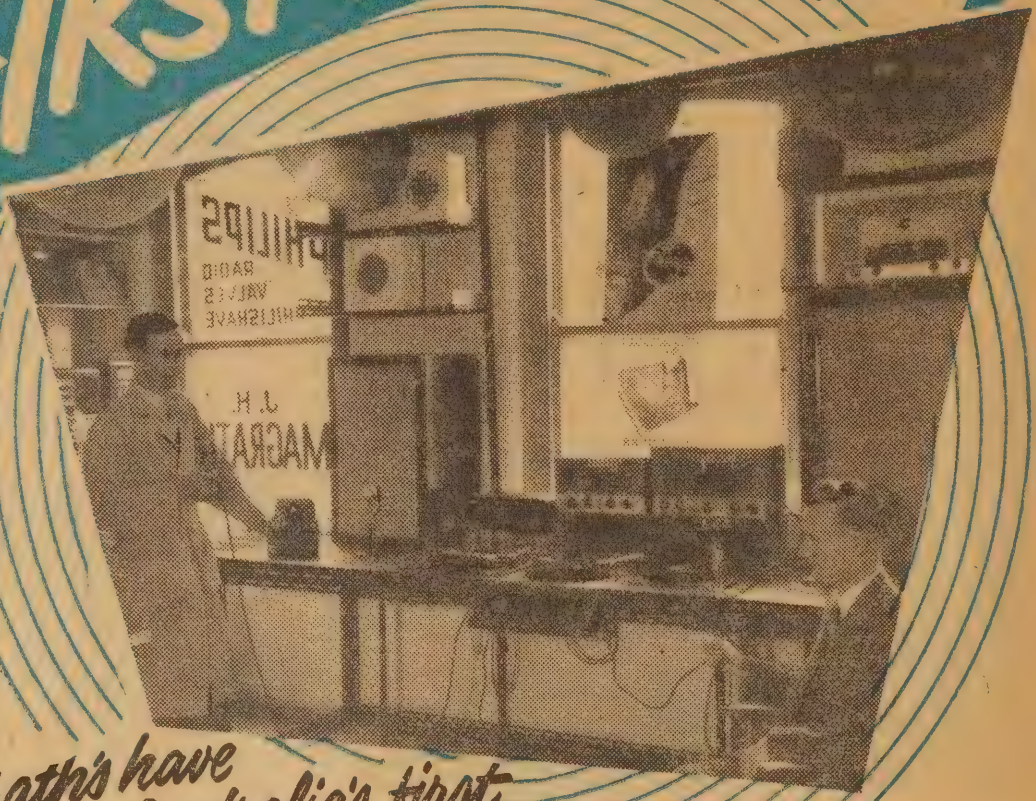
The motion of stars causes the frequency of the lines in their spectra to be altered and from the resulting change in wavelength, the velocity of the star relative to the earth can be determined. Further, it can be deduced whether the earth and star are approaching or receding from one another.

Q. Why does one, when suitably clad, feel warm on a cold still day but cold in a wind of the same temperature?

A. On a cold still day the heat radiated by the body raises the temperature of the air in contact with the body so that the temperature of the immediate surroundings is higher than the actual air temperature. On a windy day, the air in contact with the body is continually being moved and so is more nearly at the actual air temperature.

A further point is that evaporation is more rapid on a windy day than on a similar still day and this increased evaporation accounts for further loss of heat.

FIRST AGAIN!



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tank seven feet long by five feet wide and 17½ inches high. At one end is a wide plexiglass window one and a half inches thick.

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War against blowouts

BLOWOUTS, contributing factors in nearly 50,000 automobile accidents each year in the US, may soon be a thing of the past as a result of a series of tyre tests completed at Daytona Beach by the United States Rubber Co.

Exhaustive trials measured the strength of a new safety feature in passenger tyres called the "Lifewall," which the company says, has positive blowout prevention.

Principle of the safety factor is a double layer of nylon cord, which is built into the inner air container. It serves as a shield to absorb road impact and doubles the strength of the tyre.

After the tyre was ruptured under heavy punishment in the tests, the shield continued to absorb impact to such an extent that it prevented a blowout.

To measure toughness, the company put a tyre equipped with a Lifewall through stiff tests.

It was driven at high speed over a 5in steel spike and was bounced over heavy concrete blocks at 40 miles an hour. Later a car was driven around the beach, with only the nylon shields mounted on the wheels.

Even though the steel wheel rims were bent in the tests and though the tyre was ruptured in several places, there was no blowout. In other tests overheating failed to cause a blowout.

★ ★ ★

Sound washes clothes

LAUNDERING of clothes with sound pitched far higher than the human ear can hear is foreseen by Dr. Ernest Yeager, technical director of the ultrasonic research laboratory in Wayne University.

At a meeting of the American Chemical Society Dr. Yeager also said high-frequency sound might be used to homogenise milk, age whisky or destroy bacteria in water supplies.

"Sonochemistry," the science dealing with chemical effects of sound waves, promised to speed dyeing of fabrics and enable researchers to transform water quickly into peroxide bleaching solution—change cleaning fluid into chlorine gas, Dr. Yeager claimed.

"These ultrasonic waves can be used to produce both physical and chemical changes in various materials," he said.

"Examples of chemical reactions induced by ultrasonic waves are formation of hydrogen peroxide (used for bleaching) from water containing dissolved oxygen gas, formation of chlorine gas from carbon tetrachloride (dry - cleaning chemical) and modification of the chemical properties of plastics.

"The waves may be used in the artificial ageing of alcoholic beverages.

"It is also possible to use ultrasonic waves to homogenise milk, prepare paints, and even to suspend mercury, one of the heaviest metals, in water or oil.

"Research reveals we may soon be wearing clothes laundered with ultrasonic waves and drinking water treated with ultrasonic waves, to destroy harmful bacteria."

Television will require more precise measuring techniques.

ANNOUNCING

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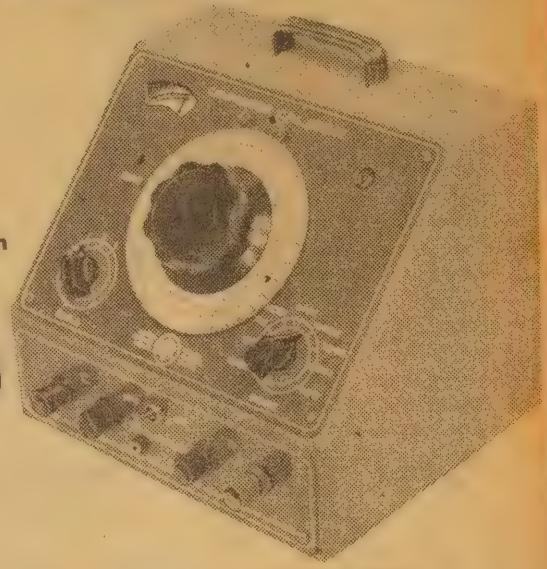

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- Uses as balance indicator sensitive electronically driven dynamometer centre zero A.C. moving coil Galvanometer.
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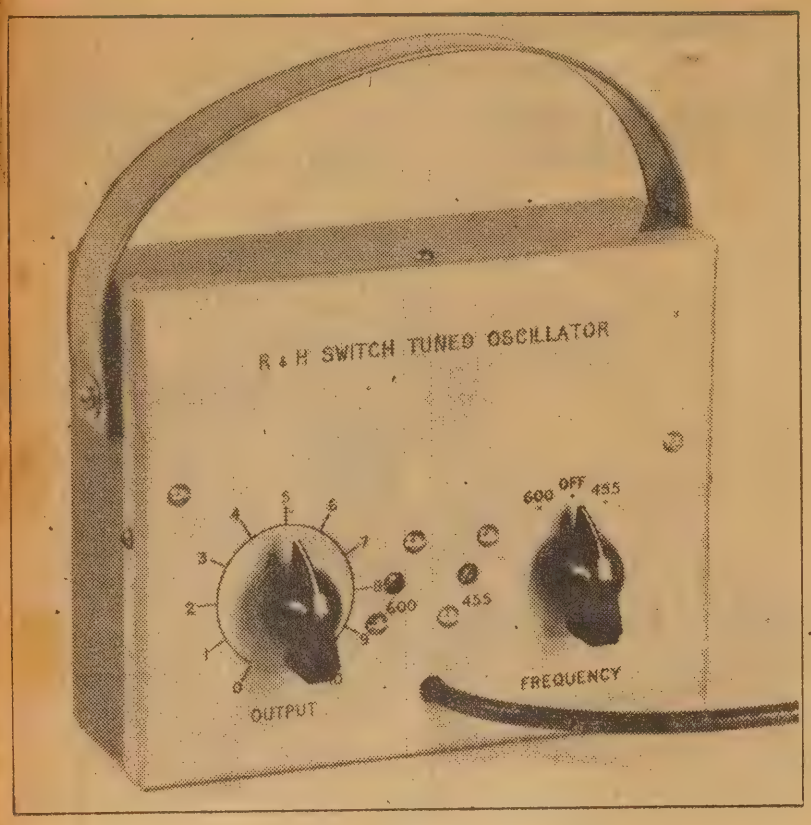


This picture gives an excellent idea of the appearance of the finished oscillator and clearly demonstrates the professional finish created by the engraved panel. Note the two adjusting screws in the centre of the panel which enable the two frequencies to be adjusted at any time. The handle, which is optional, is made from a length of plastic strap.

DESIGNED FOR HOME BUILDERS

Sooner or later every home constructor needs a modulated oscillator. Because the high outlay for a commercial instrument is frequently not justified, many beginners battle along without such facilities. In this article we describe the construction of a very simple unit, cheap and easy to build, designed especially for this class of work.

by Philip Watson

AS soon as the home constructor progresses beyond the simple one and two-valve sets and commences to think in terms of superhets, he is faced with the problem of how to align receivers of this type.

That they must be aligned is quite definite, because it is only when these final adjustments have been correctly carried out that the set will perform in the manner which its designer intended. If they are not, the results are likely to be disappointing.

It is for this reason that many beginners put off the construction of their superhet much longer than they otherwise would, or, if they do tackle such a set, often either omit this very important step or settle for a rather rough-and-ready attempt.

SIGNALS FOR ALIGNMENT

The main problem associated with the alignment procedure, at least as far as the beginner is concerned, is the need to provide an oscillator capable of generating modulated signals at the intermediate frequency and also at points close to each end of the broadcast band.

Commercial units to perform this function are fairly expensive, for the most part mainly because they provide many features over and above the bare requirements just mentioned.

Even to construct such an oscillator calls for a fair amount of financial outlay, to say nothing of the time required to build and calibrate the instrument, and it may represent too big an investment for the home constructor.

The serviceman, whether full-time or part-time, is in quite a different category, since he must be prepared to deal with any type of set which comes his way. This means that he must be able to adjust an IF channel to the variety of frequencies which have been adopted by manufacturers over the past 10 or 15 years, as well as cope with dual-wave and all-wave sets in various forms.

Thus, an instrument having continuous coverage and accurately calibrated to allow any frequency to be selected is regarded as essential, while additional features, such as accurately calibrated attenuators, audio output, &c., provide further valuable aid for work of this kind.

Because the home builder's requirements are so much simpler, a simple oscillator can still be made to fill his requirements. However, it should only cost a fraction of that of a serviceman's oscillator, require only a few hours' work to complete, and be quite simple to calibrate.

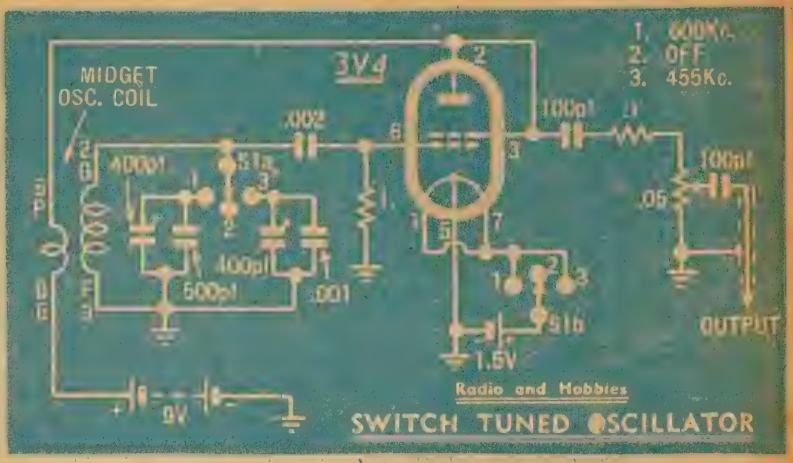
The basic idea behind such an oscillator is to provide one fixed tuned circuit adjusted to the standard IF of 455 Kc and another to 600 Kc or thereabouts. The reason why a single frequency only need be provided for IF adjustment is because this frequency is now regarded as standard, and all commercially available parts, such as IF transformers, oscillator coils, and dials are designed for this figure.

The 600 Kc signal permits adjustment of the oscillator and aerial coils for correct low frequency tracking, while the second harmonic, at 1200 Kc, may be used for adjustment of the trimmers. It is not essential that the frequency be exactly 600 Kc and some may prefer to set it on the same frequency as one of the local stations, so that its accuracy may be easily checked at any time.

If we can add a simple attenuator system and also design the circuit to operate economically from batteries, thus making it cheap both to build and to operate, the scheme begins to look very attractive.

So much, then, for the general requirements; now to consider how these were achieved in the finished instrument.

CIRCUIT OF NEW OSCILLATOR



The circuit shows just how simple the unit is and how few parts are required. The coil markings will apply to most commercially available coils and should eliminate any trouble in phasing the feedback winding. Note that the two switch sections form one complete switch.

One of the big problems with any home-made oscillator is to obtain suitable coils, and we decided that, if at all possible, we would use readily available commercial coils for this unit. At first we considered using a midget IF transformer, with one winding for the grid coil and the other one for the plate coil, to generate the IF signal; then a midget aerial coil, with the primary as a feedback winding, for the 600 Kc signal.

The midget IF transformer worked well enough, though it was necessary to screw both cores well in, in order to obtain enough feedback to maintain oscillation. The aerial coil was not a success. This was mainly due to the amount of coupling between the two windings which, not having been designed for this kind of job, was just not adequate.

OSCILLATOR COIL

Next we turned our attention to a midget oscillator coil and this not only turned out to have adequate coupling, which was more or less expected, but also to have such a value of inductance in the grid winding that it could be tuned to the two frequencies we wanted by means of a standard value mica capacitor and an adjustable padder in each case. This is a very worthwhile feature because it saves the cost of a second coil, as well as making it possible to adjust the value of either frequency from the front panel.

For a valve we chose the battery operated 3V4 output valve and powered it from a single 1.5 volt torch cell for the filament and two 4.5 volt flat torch batteries in series for the plate supply. The filament current is 100 mA while the plate current drain is a mere 20 microamps!

In spite of the low plate voltage and almost microscopic plate current there is plenty of output for the job it is to do and in most cases the attenuator will be turned well back by the time a set is correctly adjusted.

On the other hand there is not so much output that it is difficult to control, and the attenuator is completely effective when everything is housed in a metal box.

The circuit is quite a simple one but a few comments about it may help the beginner to understand the basic principles.

Oscillation is obtained by means of a feedback winding in the plate circuit of the valve and which is coupled to the grid winding. The 3V4 valve is operated as a triode by connecting the plate and screen together.

The filament of this valve is intended for operation from either 1.4 or 2.8 volts, depending on the manner of connection to the three filament pins provided. For 1.4 volt operation pins 1 and 7 are connected together and become the positive connection, while pin 5 is the negative side.

SIMPLE ATTENUATOR

RF output is taken from the plate circuit of the valve through a 100 pf capacitor to the attenuator network. The latter consists of a .1 meg. resistor and a .05 meg. potentiometer in series, the output being taken from the moving arm. The 100 pf capacitor from the plate to the attenuator serves to isolate the latter from the DC circuit, while a second 100 pf capacitor, in the output lead from the moving arm, is intended to prevent DC from the receiver under test flowing through the portion of the potentiometer between the moving arm and chassis.

The grid winding is tuned by means of a variable padder in parallel with a fixed mica capacitor. For the 455 Kc circuit a .001 mfd is used, while for the 600 Kc circuit a 500 pf is required. Each of these capacitor networks is switched into circuit as required by means of a three position, double pole switch.

The third position is "OFF," the other pole of the switch being used to control the filament circuit.

Modulation is achieved by means of the well-known "squeegee" circuit, the values of the grid resistor and capacitor being chosen to provide a suitable audio frequency.

PARTS LIST

- 1 Metal box 5¾"x4½"x2"
- 1 Engraved front panel to fit
- 1 Chassis 5½"x1¼"
- 1 Miniature 7 pin socket
- 1 3V4 valve
- 1 Midget oscillator coil. (Brameo MO-2-1R5, or similar)
- 1 2 pole, 3 position switch. (MSP series 20, type 28, or similar)
- 1 1 megohm ½ watt resistor
- 1 .1 megohm ½ watt resistor
- 1 .05 megohm potentiometer
- 2 100 pf mica capacitors
- 2 400 pf adjustable padders (Jaybel or similar)
- 1 .001 mfd mica capacitor
- 1 500 pf mica capacitor
- 1 .002 mfd mica capacitor
- 1 1.5 volt torch cell (Type 950 or similar)
- 2 4.5 volt torch batteries (Type 703 or similar)
- 1 yd PTIM coaxial cable
- 2 alligator clips
- 2 pointer knobs
- 1 2 terminal tag strip
- 1 Plastic handle (optional)

Nuts, bolts, hookup wire, self tapping screws etc.

The principle of this system of modulation is quite simple and its operation is mainly dependent on the value of the grid resistor (1 megohm in this case). This value, in turn, governs the value of grid bias generated when the valve commences to oscillate and, if it is made large enough, the bias will eventually build up to a value which will prevent oscillation.

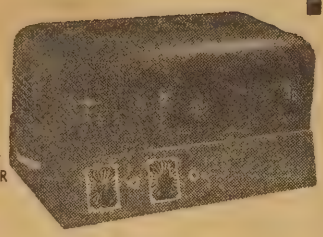
As soon as oscillation ceases the generation of bias also ceases and the charge already on the grid commences to leak away through the grid resistor, eventually dropping to a value where oscillation will recommence. Thus the oscillation starts and stops at a frequency dependent on the value of the grid resistor and condenser and, if this starting and stopping is made to occur at an audio frequency, the oscillator will be modulated at this frequency.

RESULTS ARE GOOD

Rude remarks are frequently made about this method of modulation, the main accusation being that it produces a broad signal, both as a result of amplitude modulation in excess of 100 pc, and a tendency to frequency modulation. There seems little doubt that both these effects are present, but the important point to be considered is by how much they adversely affect the performance of the unit in the job it is to do.

Whatever degree of frequency modulation is present, it appears to be completely masked by the heavy amplitude modulation so that the unit actually appears to give a very much better signal than many circuits which attempt to modulate an oscillator from a separate audio generator. These often produce a signal with two distinct modulation humps either side of the nominal carrier frequency and alignment with this type of signal can be extremely difficult.

The heavy amplitude modulation, while it produces sidebands which extend well to either side of the carrier frequency, still produces a signal in which the actual carrier frequency is clearly defined by a peak audio



25 WATT AMPLIFIER

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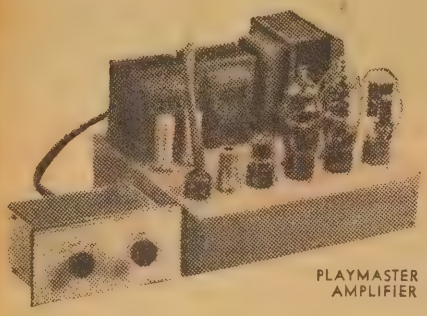

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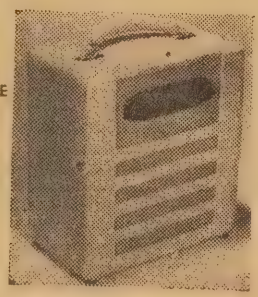

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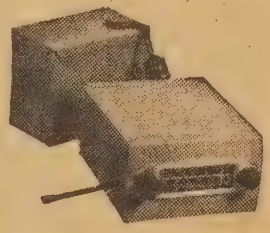

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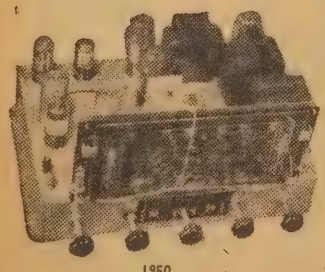

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signal in the output of the set, with no sense of ambiguity. This, after all, is the main requirement.

For our original unit we made up a small aluminium box measuring 5¾in x 4½in x 2in deep, together with a close-fitting lid. These dimensions are the same as those used for the line-filter box described in the January issue. Since we required a box of approximately this size, it was convenient to standardise, thus simplifying the supply position for ready-made boxes.

Additional holes will be required in the front panel and a small chassis is needed to mount some of the major components. Full details of these changes will be forwarded to the chassis manufacturers and ready-made boxes should be available by the time this article appears.

FRONT PANEL

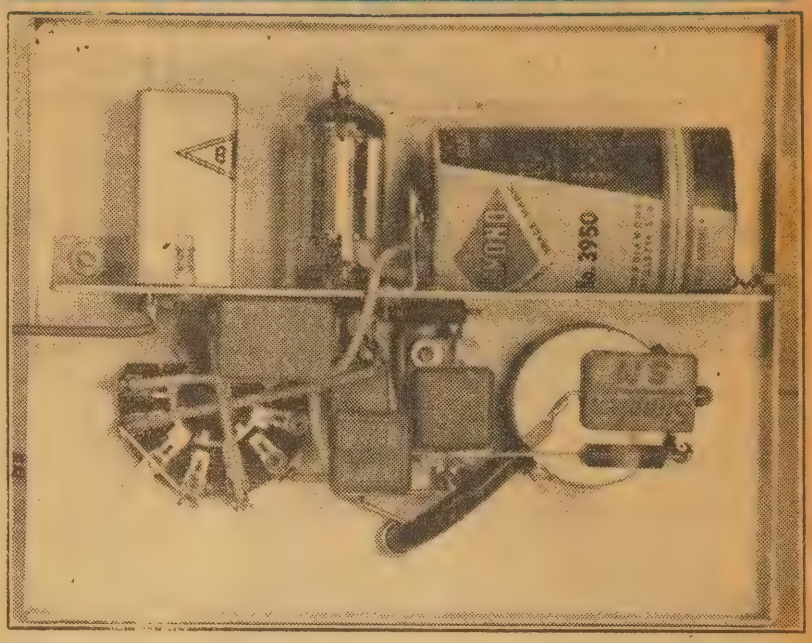
In order to identify the various controls, it will be necessary to mark the front panel in some way, and we took ours to a professional engraver, who finished it to our own specifications.

The result can be seen in the photograph and we would seriously recommend that home constructors also have this done before commencing assembly of the unit.

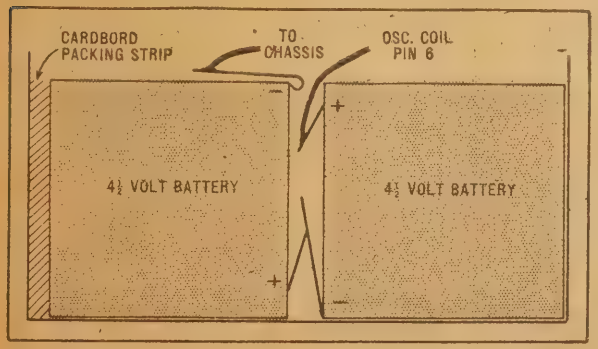
The cost is small compared with the convenience and enhanced appearance it provides and our advertisers have been supplied with the necessary details to enable them to provide readers with a similar job to the original.

As may be seen from the photographs the chassis is attached to the front panel and provides a mounting for the valve, the coil, and the filament cell. The remaining major components are the frequency switch, which also serves as an on-off switch, the attenuator, and the two variable padders which are used for final frequency adjustments. All these are mounted on the front panel.

REAR VIEW OF THE OSCILLATOR



A picture of the "works". Above the chassis are the coil, valve, and filament cell, while below it the switch and attenuator pot can be clearly seen. Between them are the two adjustable padders, one of which can just be seen alongside the pot. The plate batteries are in the rear of the case.



A sketch showing how the plate batteries are accommodated in the rear of the case. By bending one contact along the side of the battery, a series connection is possible by simply mounting the two batteries end to end. A layer of cardboard is desirable to insulate the batteries from the case.

The original coil was a Bramco type M-02 OSC. 1R5, and we have shown the pin numbers of this type on the circuit diagram in order to eliminate any problems associated with correct phasing of the feedback winding. There is no reason to suppose that a similar coil from another maker would not perform in exactly the same manner and, in all probability, the pin numbering system will also be the same.

The two 4.5 volt batteries are housed against the rear of the case, two short lengths of hook-up wire connecting them into the circuit, but allowing the front to be removed without disturbing them. By bending one of the long contacts (negative) so that it lies along the side of the battery, the two batteries may be placed in the case end-to-end so that a series connection is automatically provided.

It is a good idea to insulate the batteries from the metal case by means of a piece of cardboard, though this is mainly a precaution against any possibility of the outer case of the battery being damaged. The batteries will be held more firmly in place if a small wedge, made by folding a piece of cardboard several times, is placed between the bottom of one battery and the side of the case.

The filament cell is mounted on the chassis and the connections to it also serve to hold it firmly in place.

The outer case is connected to the chassis by soldering it to a short length of tinned copper wire which is fastened to one of the chassis mounting bolts. The positive connection is made by mounting a two-terminal tag strip on the chassis in such a position that the insulated lug rests against the brass cap of the cell. The brass cap is then soldered to the terminal and wire run to the appropriate switch contact.

For the output cable we used a length of PT1M coaxial cable, though it would be possible to use a length of shielded hookup wire.

FIXING CABLE

However, quite apart from the desirable electrical qualities of the coaxial cable, it also has excellent mechanical characteristics. It should be anchored to the potentiometer cover by soldering to the outer braid after unravelling a short length of it, while further protection against twist and strain is provided by wrapping several turns of tinned copper wire around the cable where it passes through the chassis.

One end of this may be anchored to the earth wire bridging the two padder terminals.

The other end may be conveniently terminated in a pair of alligator clips, one for the active centre lead and the other for the outer braid. The alligator clips should be of the tubular type normally used on test prods and, with a little care, it is possible to reduce the bore of the tubular portion until it is a neat fit over the insulation around the centre conductor.

The outer braid should now be unravelled for about one inch, about a quarter of an inch of the centre conductor bared, and the tubular portion of the clip forced over the insulation. The conductor may now be soldered to a convenient spot on the clip and the tubular portion squeezed tight, so that it grips the insulation.

Six or eight inches of hookup wire should be soldered to the outer braid,

The WARBURTON FRANKI Page

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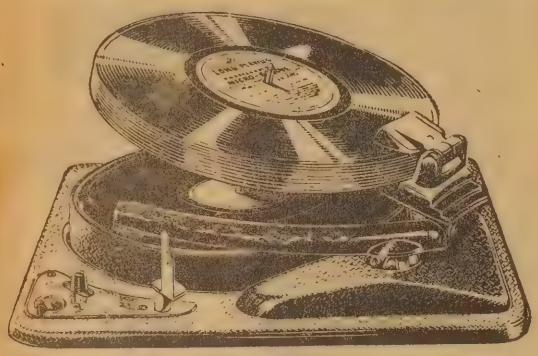

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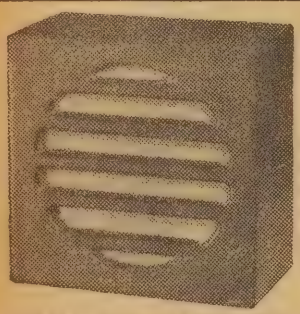

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where it has been unravelled and twisted and over this is slipped a length of spaghetti or plastic tubing. The other end of the hookup wire is also terminated in an alligator clip with the insulation clamped in the tubular portion.

The padders we used have a nominal capacitance of 400pf and are small enough to be easily accommodated on the panel alongside the switch. Watch the size of any alternative brands which may be larger physically and difficult to mount.

It is also important to connect these the right way around, the plates connecting to the adjusting screw going to earth. If this is not done it will be difficult to adjust the tuned circuits because the presence of the screwdriver will upset the tuning.

CALIBRATION

When the oscillator is completed and working it will have to be correctly calibrated, and there are several ways in which this may be achieved. Probably the best method is to compare it with another oscillator known to be accurate at 455, and this may be done by connecting both oscillators lightly to a receiver IF channel, already adjusted to 455 Kc.

It should now be possible to beat the two signals together, the difference between them appearing as an audio signal which becomes lower in frequency as this difference is decreased. For this test, it will probably be advisable to use an unmodulated signal from the standard oscillator.

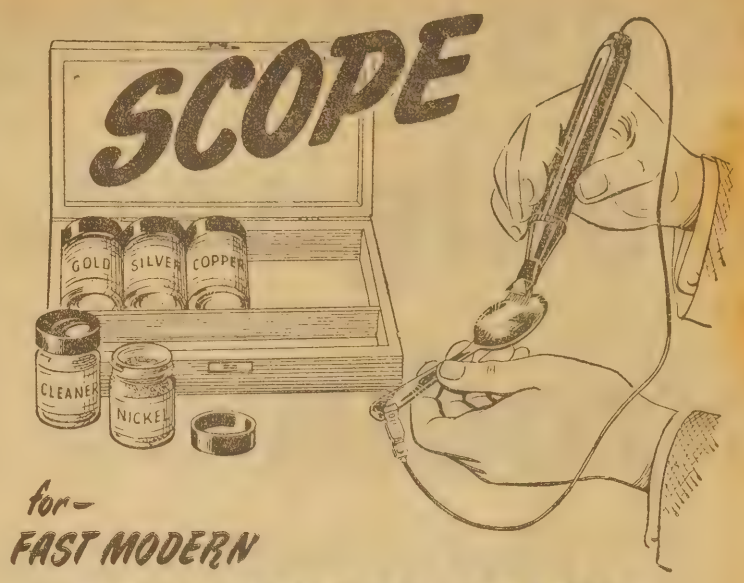
The next best method would be to use a receiver which it was known was accurately tuned to 455 Kc. In this case, the oscillator would be simply connected to the IF channel, and the oscillator tuned circuit adjusted until maximum output was obtained from the receiver.

A further check is possible by tuning in a harmonic of the IF signal on the broadcast band, and noting whether it corresponds with the expected dial calibration. The second harmonic will occur at 910 Kc, and the third at 1365 Kc. To make this check, the signal should be fed into the aerial terminal, which will produce a signal that spreads right across the dial, due to a portion of the input reaching the IF channel. However, as the receiver is tuned over a second or third harmonic, there will be an additional response from the receiver, in the form of a louder signal.

RECEIVER ACCURACY

In some cases the increase will be slight and care may be necessary to observe it, but it should be possible to get an indication of some kind. The accuracy of this test is mainly dependent on the accuracy of the receiver calibration at the particular points on the dial, and this can be checked by noting where local stations are received relative to the calibration markings.

When these few simple adjustments are made the instrument may be regarded as complete and the owner may feel assured that he has a reliable means of adjusting the IF channel on any set he makes, as well, perhaps, as those of his friends. When the IF channel is correctly adjusted most of the alignment problems are over, but, with the added feature of two signals on the broadcast band, there is no reason why the set should not be adjusted for first-class performance.



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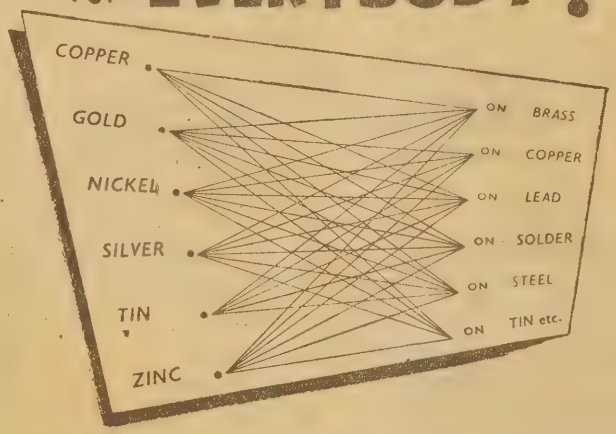

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HOW TO USE YOUR OSCILLATOR

As we have already emphasised in the constructional article on the Switched Tuned Oscillator, it is very important that any superhet be correctly aligned if it is to give maximum performance. Here, then, is a discussion on just how to set about this very important job.

THE equipment you will require will be the modulated oscillator, an output meter and a set of insulated aligning tools to suit the various adjusting screws in the receiver. The modulated oscillator has already been discussed, but a few comments about the other items may be helpful.

The output meter is an AC voltmeter which connects to the plate circuit of the output valve and gives a visual indication of the volume of sound in the speaker.

EAR LIMITATIONS

This is a very important facility, because the ear is relatively insensitive to changes in volume and can easily overlook small improvements in performance with each adjustment. By the time this possible error is multiplied by all the adjustments required it can add up to a considerable total, and may mean the difference between good and mediocre performance.

Any multimeter equipped with AC ranges is suitable for use as an output meter and, in most cases, an "output" switch position is provided which brings a capacitor into circuit in series with one lead from the set. The purpose of this capacitor is to prevent any DC flowing from the output valve plate circuit and through the meter, but at the same time allowing the signal currents to pass and be registered on the meter as a certain volume level.

In the event of a meter having AC ranges but no output meter facilities, it is quite easy to add these by simply connecting a capacitor of between .1 mfd and .5 mfd in series with one lead from the set. It should have a working voltage rating of at least 400.

The output meter is connected between the plate of the output valve and chassis and should be set, initially, to the highest voltage range. Lower ranges should not be selected until the signal from the oscillator has been tuned in and the level adjusted to a reasonable value.

AVOID OVERLOADS

Care must be taken to avoid sudden bursts of signal which would overload the meter and it is extremely unwise to tune across the band in search of a signal while the meter is set to one of the lower ranges. Such a procedure can easily lead to a ruined meter.

The first step in the actual alignment process is to adjust the IF channel so that each tuned circuit (there are normally four) is set to exactly 455 Kc.

To do this, the output lead from the modulated oscillator should be connected to the signal grid of the converter valve, with the shielding braid connected to the chassis. Even without any adjustment it should be possible to force a signal through by advancing the attenuator on the oscillator and setting the gain of the receiver to maximum.

In any case it is desirable to keep the gain of the receiver fully advanced and reduce the output from the oscillator as the various stages are brought into line. Main reason for adopting this procedure is to avoid any adverse effect by the AVC system, which would normally attempt to compensate for any increase in sensitivity brought about by the adjustment of the tuned circuits.

By keeping the gain of the set at a maximum and the input from the oscillator at a minimum, the signal level is kept below the value normally required to set the AVC into operation, and is thus a simple method of rendering it ineffective. In order to avoid unwanted signal and noise pickup while the set is in this condition, it is sometimes helpful to short the aerial terminal to chassis.

In some cases it may be found necessary to retard the attenuator almost completely in order to reduce the signal to the required level, and some potentiometers may not be as smooth as could be desired when used in this way.

It is difficult to avoid this problem in the design of the instrument without complicating the attenuator system to a degree which is undesirable in a simple instrument, but it may be simply overcome in use by clipping the output of the oscillator on to the insulated portion of the wire concerned. The capacity coupling thus provided will reduce the signal appreciably.

IRON CORES

Modern IF transformers are fitted with adjustable iron cores controlled by a brass screw protruding from the top and bottom of the can. Each controls one of the two windings forming the transformer, and operates on the simple principle of moving the iron core further into or out of winding.

When all the gear has been set up and a signal from the oscillator is being indicated on the output meter, each of the iron cores should be adjusted to give the maximum indication on the meter. Some workers prefer to follow a set order, such as commencing with the secondary of the second IF and progressing toward the converter, but such a procedure does not appear to be absolutely essential and, except in special cases, any order may be adopted.

It is, however, important to realise that the adjustment of one winding in a transformer will have some effect on the other winding, particularly if the first winding required considerable adjustment to bring it into resonance. For this reason a "once over" technique is hardly sufficient and it is advisable to repeat the whole process at least once and, if the adjustments were initially a long way out, even a second time.

With certain IF transformers, particularly the early adjustable iron core types, it is possible to produce a false peak by screwing the cores too far in.

When this happens the cores are so close together that they provide additional coupling between the windings before they can be removed far enough from the windings to tune them to resonance. This results in a broad peak, frequently lop sided, which gives poor gain and selectivity. If in doubt commence with the core screwed well out and use the first peak which occurs as it is screwed in.

MAKE SURE

It is worth while spending a little extra time to make sure that the IF channel is really properly adjusted, since it is upon this, as much as anything else, that the final performance of the set depends. These remarks apply particularly to the beginner, who can learn a great deal from a session of "mucking about" with an IF channel and an oscillator.

When this part of the job has been done to complete satisfaction the next stage may be proceeded with. This is to adjust the tracking between the aerial and local oscillator circuits at points close to (but not right at) each end of the band.

Before proceeding with electrical adjustments in this part of the set it is advisable to check the mechanical setting and operation of the dial and tuning gang. All the movements should operate smoothly and, if they do not, the necessary adjustments should be made at this stage.

Also check whether the dial glass is square with the chassis and will line up correctly with the escutcheon when fitted to the cabinet. Finally, adjust the pointer so that it swings equally to each end of the dial when the gang is open or closed.

Now switch the output meter to the highest voltage range (an important precaution) and then connect the output leads from the modulated oscillator to the aerial and earth terminals of the set. Switch the oscillator to 600 Kc and tune the set to this region of the band when it should be possible to receive the signal at a point close to the 600 Kc marking on the dial.

In many cases it may be possible to receive the signal with the pointer exactly on calibration, even though the loudest signal is obtained at a point to one side of this marking. If so, the pointer should be set exactly on calibration and the adjustable iron slug in the local oscillator coil adjusted for maximum output. This is followed by a similar adjustment for the aerial coil.

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In the event of no signal being audible when the pointer is set to the 600 Kc marking, it will be necessary to locate the signal and determine, by experiment, in which direction the local oscillator slug needs to be turned in order to move the signal toward the calibration marking. Once it is brought close to this point the procedure is as before.

The foregoing is based on the assumption that a fixed padder is used, which is normally a standard arrangement when the inductance of both the aerial and local oscillator coils can be varied by means of iron cores. When the aerial coil inductance cannot be varied it is usual to fit an adjustable padder, which calls for a somewhat different procedure.

PADDER ADJUSTMENT

Many portable sets come into this category, being fitted with loop aerials which have a fixed value of inductance and so cannot be adjusted to track with the local oscillator circuit. There are also many older sets which use a variable padder and, although this oscillator is not intended as a service instrument, it is possible that it will be useful in this role on some occasions. For this reason it may be a good idea to discuss the procedure used in these cases.

A 600 Kc signal is used as before and this is tuned in for maximum output; the emphasis being on accurate tuning rather than dial calibration at this stage. The output meter is particularly valuable in determining when the correct tuning has been achieved, and also in the subsequent operation of determining the correct padder setting.

The reading on the output meter should be noted and the padder then adjusted about a quarter turn in (say) a clockwise direction. This will normally cause the signal strength to drop, though we are not particularly interested in what happens to it at this stage. The tuning gang should now be retuned until the signal is once again received at maximum strength and it is this new value, compared with the original, which indicates what progress has been made toward correct tracking.

If the signal strength is now greater than before it indicates that the padder adjustment was in the right direction (though not necessarily by the correct amount) and the process should be repeated, giving the padder another quarter turn clockwise and again retuning the gang to note the effect.

If the signal strength is reduced by this adjustment the padder should be returned to its original setting and then given a quarter turn anticlockwise. Once again the effect of this adjustment is indicated by the strength of signal when the gang is retuned.

When an indication has been obtained as to the direction in which the padder needs to be adjusted it should be moved in this direction in small steps at a time, the signal strength being checked by retuning the gang after each adjustment, until a point is reached where no further improvement can be made. The two circuits may now be regarded as tracking correctly and it only remains to adjust the calibration in order to complete the operation.

Ideally, the setting which gives maximum gain should also give correct calibration, but this will only happen when the inductance of the aerial coil (or loop) is exactly right, a condition seldom encountered in practice. More usually the pointer will be found to be slightly off calibration and this is most easily corrected by loosening the coupling between the dial and gang and shifting the setting until the calibration is correct.

The next step is to adjust the trimmers, and this job is performed at the high frequency end of the band, somewhere between 1200 and 1400Kc. When using the Switch Tuned Oscillator the second harmonic of the 600Kc signal will provide a signal at 1200Kc.

Once again the aim is to adjust the circuit so that this signal is received when the pointer is opposite the appropriate calibration marking on the dial, and the normal procedure is to set the pointer correctly and then adjust the local oscillator and aerial trimmers (in that order) until maximum output is obtained. As with the adjustment at the low frequency end, it may be necessary to search for the signal and move it towards the calibration marking before the final adjustment can be made.

FINAL CHECK

With the completion of the trimmer adjustments the alignment is virtually complete, but it is a good idea to return to the low frequency end and check that the calibration has not altered significantly. In most cases it will not have been affected but a slight "touch up" may occasionally be necessary when the trimmers have been moved over their full range.

While the foregoing should enable the home constructor to make the best use of his oscillator for receiver

(Continued on Page 81)

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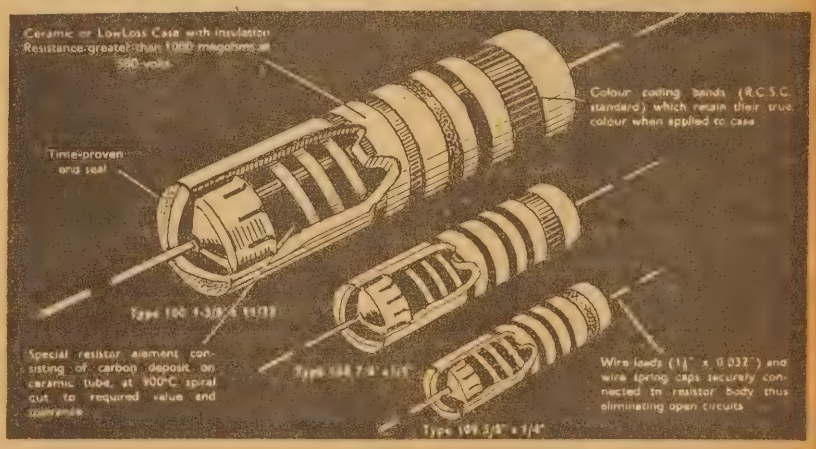
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Here's your answer, Tom!

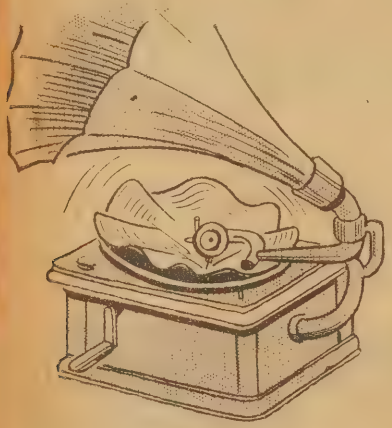
All the recent discussion about microgroove records — their better fidelity and long-playing characteristics — has apparently spurred Tom to check up on the position. By the look of it, that's about all he'll be able to do.

TOM'S dilemma is unfortunately shared by the large majority of would-be music lovers who find themselves beyond the reach of the AC power mains. But let's take the questions in order.

I have a couple of questions to ask, but first could you explain in a few words how a phonograph works? I mean the ordinary type that doesn't have to be connected to the wireless.

To do the job properly, Tom, we'd have to set about with all kinds of little diagrams and go through explanations which might interest only a very few of our readers. However, let's skip the preliminaries and see what we can do in a couple of paragraphs.

In the ordinary phonograph to which you refer, the tiny "wiggles" in the recorded grooves vibrate the



needle point rapidly from side to side.

If you look carefully at the assembly, you'll see that the vibrations of the needle are transferred by a tiny lever arrangement to a mica diaphragm and this, in turn, is made to vibrate in sympathy with the needle.

VIBRATIONS AND SOUND

Now the vibrations of the diaphragm set up vibrations in the air alongside it and these are, in effect, weak sound waves corresponding to the original sound, which you could hear by listening carefully. But, on their own, they would be too weak to have any entertainment value.

So, Tom, one side of the diaphragm faces into the hollow "tone arm." You will notice that this expands in size toward the base end and, underneath the motor board, the cabinet work is arranged to provide a horn which butts against the base of the tone arm and which itself gets larger and larger toward the mouth.

This "horn," which thus extends right from the diaphragm to the outlet of the cabinet, allows the sound waves from the diaphragm to be heard to better advantage.

The better the acoustic design of the horn, the louder and clearer will be the sound issuing therefrom. That is why a good console phonograph always sounds better than its little portable counterpart.

The energy to vibrate the needle and diaphragm is supplied from the rotating record grooves and the dimensions of the ordinary 78 rpm record grooves are such that they can supply enough energy to create enough direct sound to be heard under quiet listening conditions.

This isn't really surprising, Tom, considering that 78 rpm records were originally developed for just that purpose!

This leads neatly into your next question:

I have heard a lot about the new microgroove recordings. Is there any chance of playing these on an ordinary phonograph because there is no power here to run a 3-speed radiogram?

We could answer your question in one word, Tom. No!

Rather than leave it at that, it might be a lot more helpful if we explained the position in detail.

Unlike 78 rpm records, the microgrooves were never intended to be used on acoustic gramophones. Broadly speaking, the grooves are just too fine and delicate for the job.

TREAT THEM GENTLY

A needle point coupled to a bulky diaphragm requires a good deal of pressure from the groove walls to vibrate it rapidly from side to side, and a good deal of downward pressure if it is to stay in the grooves at all.

Treated in this fashion, we don't think that the average microgroove would last too long. It might start to look like the one our artist has depicted.

What is more, even if it did stand up to the punishment, it is doubtful whether the scaled-down grooves would generate enough direct sound in the voice box to be of use.

An electric pickup is a very different proposition. Every effort is made, in modern types, to free the movement of the needle (let's call it the stylus) and to avoid vibrating rods and levers. In its travel, the needle only has to disturb a magnetic field or move a tiny coil of wire, or bend a tiny piece of crystal or perform some other equally simple task.

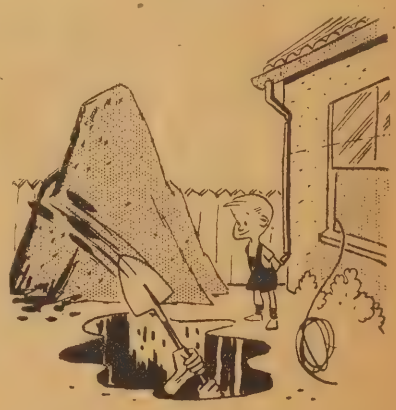
Whatever the method, the end result is a tiny electric current which is subsequently amplified by electrical means to drive a loudspeaker.

There is one other point, Tom, namely that it might be very difficult to design a spring motor which would run smoothly at 33 rpm for the whole 20 odd minutes necessary to play a microgroove disc. We don't say it's impossible but we haven't heard of it being done on a commercial scale.

IT'S A HARD WORLD

If you want to go further in the business, Tom, you'll have to investigate the matter of an amplifier and speaker and a pickup capable of being used on either 78 or microgroove. That will allow you to play ordinary records.

If you want to play microgrooves and there isn't any prospect of the AC mains coming your way, you'd better start thinking in terms of a 50-cycle AC inverter that will run



from a lighting plant and operate a conventional 240-volt motor and amplifier.

Yes, we know it's hard!

Is it a good thing to bury the earth wire deeply? I don't mind a bit of extra work if it will mean improving results.

That's an abrupt change of subject, Tom, but we can just imagine

your enthusiasm. In fact our artist has imagined it!

Fortunately, you don't normally have to start making huge excavations for the radio earth, because it doesn't have to be one of these low resistance paths that Councils insist on for electrical installations—blowing 15-amp fuses and all that.

A "good" earth from the radio viewpoint is constituted by a connection to an existing water service or to a length of water pipe driven two or three feet into moist ground.

Some like to solder a wire to a tin and bury it a couple of feet down but a plain ordinary pipe is a lot easier and generally just as good.

And, if the ground isn't normally moist, you can easily fix that with a dish of waste water every now and again.

If the frequency of the power mains were increased beyond audibility, would a receiver need to have a filter in its power supply?

Yes, Tom, we guess that a filter would still be necessary. The unfiltered output from the rectifier might cause all sorts of undesirable effects and except under very special circumstances, such a receiver would not be usable.

ECONOMIC CONSIDERATIONS

True, with a high frequency power supply the filter can be made much less expensive and much more compact. In some cathode ray oscilloscopes a valve is used as an oscillator to generate supersonic power which can be stepped up in potential, rectified and filtered at less expense than the 50 cps direct from the power mains.

This is true only where very high voltages are involved and the cost of the oscillator valve and the high frequency transformer is defrayed by the smaller cost of the 50 cps transformer, filter choke and filter condensers.

However, the cost of radio filter circuits is only a drop in the ocean compared with the cost of power distribution and our electrical engineer friends are not likely to be impressed by talk of a couple of extra pounds for filter components. Apparently, experience has shown that a frequency of between 40 and 60 cps is most convenient. Lower frequencies make it necessary to use more iron in the various transformers while higher frequencies tend to increase the copper costs.

Is it possible to tape record from a broadcast receiver or must you use an amplifier?

You are optimistic in both cases, Tom. It isn't possible to tape records from either an ordinary radio or amplifier. The reason for this is that a special high frequency bias voltage is required, and for this an extra valve and associated components must be included.

Because the output from the tape is low, a preamplifier is generally required if you are to successfully reproduce your tape recordings.

The best we can do, Tom, is to refer you to the article on page 48 of the January, 1953, issue, which described an excellent tape recorder adaptor.

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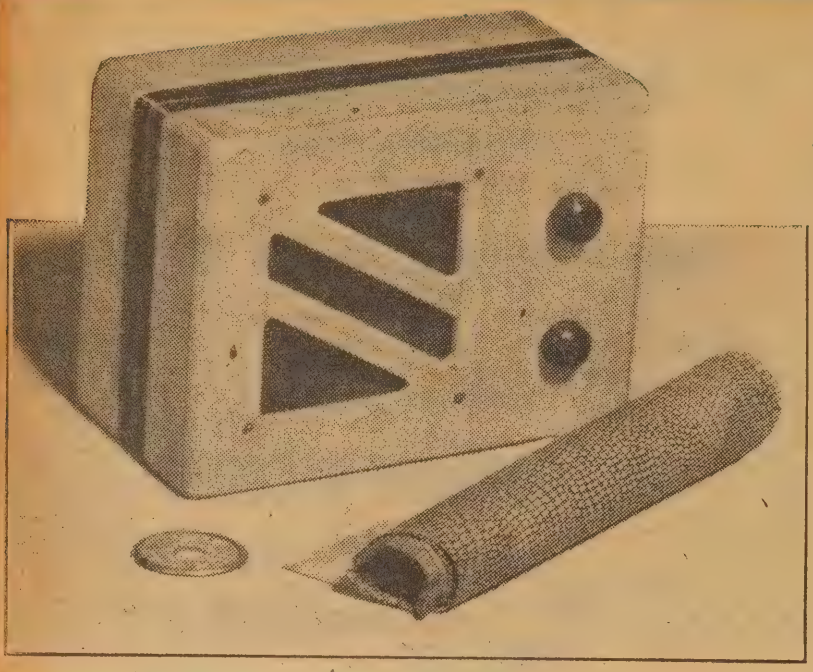


We suggest that you follow our example and test the set in the cabinet before the leatherette covering is applied to make finally sure that your loop is in order. When the job is complete, a carrying handle can be secured by means of screws passing through the space between the two windings of the loop.

Teach Yourself Radio (7)

TRY YOUR SET AS A PORTABLE

If any bouquets are due this month, let them be delivered to some of our readers. During the past few weeks we have received a number of letters suggesting that the parts used in the previous receivers would serve equally well for a small self-contained portable. In practice the idea proved well worth while and the result of our interpretation is described here.

by Maurice Findlay

IN addition to the relatively large number of parts required, a conventional superhet portable presupposes a certain amount of experience with wiring techniques and a knowledge of the alignment procedure. There are plenty of people who would not be in the least frightened by the prospect of building such a set.

STEP BY STEP

But there are others to whom every additional component and every adjustment is an additional reason for concern. They will build superhets with the best of us when the time comes, but just at the moment they feel like taking the ladder step by step!

Plenty of audio gain was the main feature of the switched coil short-wave job described last month, this being necessary in order to bring the relatively weak signals from overseas stations up to a listening level.

By the same token, the loop aerial used for a portable doesn't have anything like the pickup of an ordinary aerial on the broadcast band, so that a high gain is needed to bring the broadcast signals up to loudspeaker level.

Briefly, then, the idea of the new set is to substitute a loop aerial for the aerial coil of the conventional regenerative receiver. Feedback is provided via a second loop wound alongside the first. The reaction is controlled in exactly the same way as last month's set, a variable condenser being wired in series with the loop so that the radio frequency current through the loop can be varied at will.

Experience has proved this method of controlling reaction superior to other methods which involve a potentiometer in the screen circuit, with these particular valves at least. The objection to the screen method is that it is not possible to adjust the coil so that the valve will go into oscillation with the optimum screen voltage at all positions of the tuning dial or with different values of aerial loading.

FEATURES OF LOOP

Most of you will be familiar with the idea of a loop aerial, but a brief review of its features will serve to refresh your memory.

Essentially it is a coil of wire. It may consist of anything from one to a large number of turns, depending on the purpose in mind. Some loops are exactly round, although more often in portable receivers it is more convenient to have them of a rectangular shape.

Sometimes the turns are wound in the form of a flat spiral and sometimes they are wound so that the mean diameter of each turn is the same. The choice is merely a matter of mechanical convenience, the performance in each case being about the same.

For broadcast reception loops may be anything from a few inches in diameter to several feet. In general the larger loops are more efficient but, of course, are more difficult to handle. Excellent results can be had with loops of about 6 inches diameter or more, so that it is not usual to make the receiver larger than necessary in order to accommodate a larger loop.

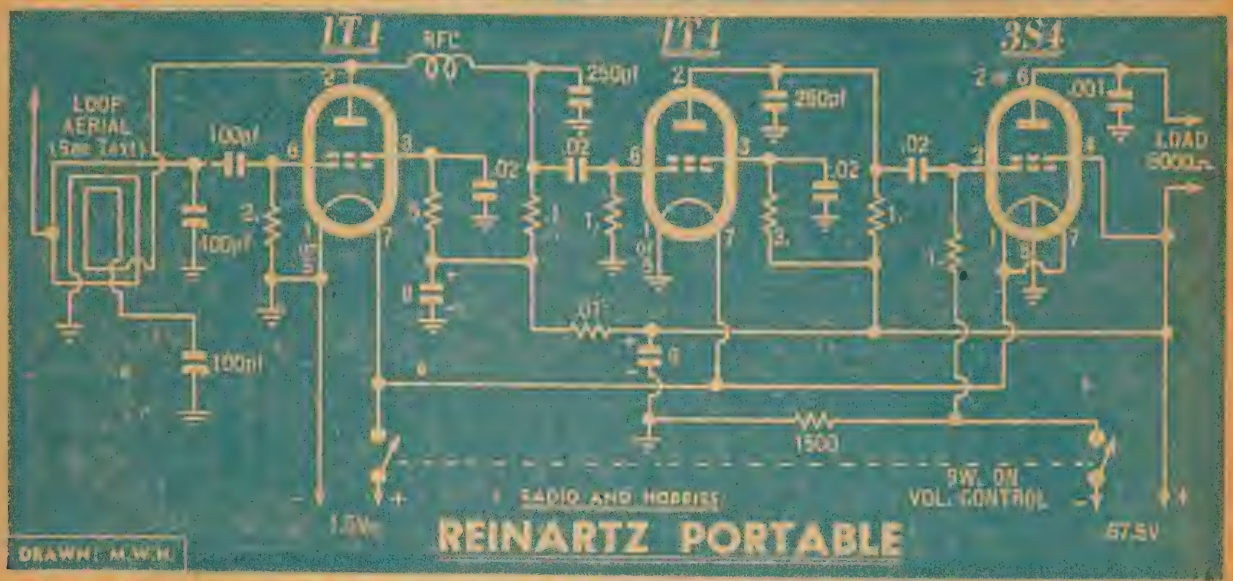
Reception with a loop aerial is best when the loop is pointed toward the station and poorest when the loop is at right angles to the station. This feature is particularly important, because it means that loop aerials can be used for direction finding.

DIRECTIONAL CHARACTERISTICS

For this purpose it is usually easier to turn the loop for the weakest signal on a particular station when it will be at right angles to the required direction. The direction will be quite sharp and a few degrees either way will make a great deal of difference. This is a point to remember with any set using a loop aerial.

The directional qualities of a loop

PORTABLE CIRCUIT FEATURES BUILT-IN AERIAL



The circuit is quite straightforward and you can be sure of duplicating the results of the original. The reserve of gain when using the loop is not so great as to warrant the inclusion of a volume control.

may actually be an advantage in the case of a simple portable receiver. It is true that there will sometimes be cases where it will be necessary to turn the set slightly either way in order to receive a particular station. However, there will be cases when it will be possible to reject an unwanted station by turning the loop at right angles to its direction when it would not be possible to reject it by means of the normal selectivity of the receiver.

On the debit side, the loop is particularly sensitive to the presence of the operator's body or nearby metal objects. Both the tuning and the reaction setting are affected if a hand is placed close to the loop.

An ordinary superhet portable does not suffer from this disadvantage to the same extent because its gain and selectivity are not so intimately dependent on the loop.

DISADVANTAGES

In practice, this means that the regenerative portable is somewhat more critical to adjust than a superhet and can easily be put out of adjustment if shifted from one position to another. For example, it probably wouldn't make much difference to a superhet if it were placed on a stone fence. With the regenerative portable the same treatment would result in a marked drop in performance.

In one particular test we found that standing the set on a couple of matchboxes to get it clear of its support means the difference between only being able to get a couple of stations and being able to get all local stations at full speaker level.

Don't be discouraged by our recital of the bad points about the set. Given the right conditions it does work, and work well, but it cannot be expected to outperform a set costing twice the money.

Last month's shortwave set was designed with a view to ease of wiring. The chassis was designed to accommodate all components, leaving plenty of space. You could, of course, make a cabinet large enough to take this chassis together with the speaker and batteries. This would add up to a fairly bulky receiver with much of the space going to waste.

As it is, without unduly crowding the components, the complete receiver has been fitted into a cabinet of inside dimensions 7½ x 5½ x 3½ inches. This allows room for the largest of the current 5in speakers and also for a large 1.5 volt cell.

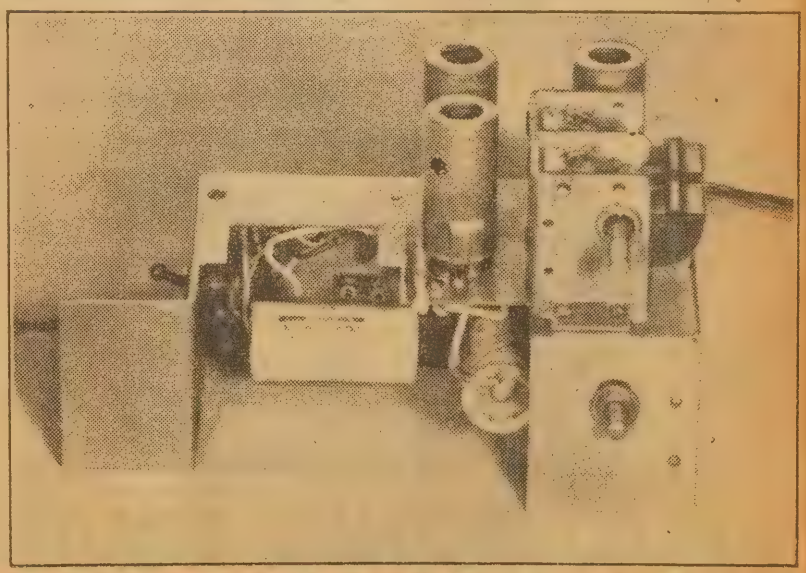
It is well known that for a given electrical input the 5in speakers are capable of much greater audio output than the 3in types. There is also quite an improvement in tone with the larger speaker.

The speaker is mounted on the cabinet and should be placed so that

LOOP DETAILS

The loop is wound around the outside of the wooden cabinet the outside of which is 8¼in x 6¼in. The tuned winding consists of 21 turns of No. 24 B & S wire closewound. Taps are made at 5, 10 and 15 turns for the connection of an external aerial.

The reaction winding is closewound with 15 turns of the same wire and is wound ⅛in from the earthed end of the tuned winding.



From front of the chassis the 1.5 volt cell fits between the coil assembly and the end of the chassis which is bent around to support it. The 67.5 volt battery is supported above the chassis alongside the 1T4 amplifier valve.

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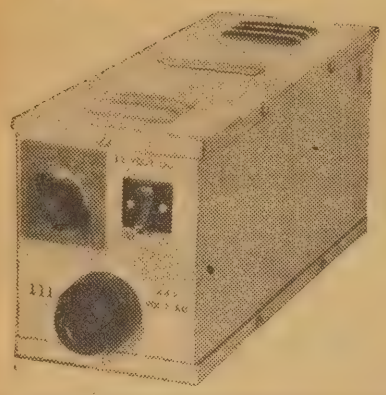

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it does not prevent the chassis sliding into position. You will, of course, carefully check the point for yourself, but it will be found that, looking from the rear of the cabinet the speaker will be on the right-hand side and within about 1-8in of the end.

Ordinary wood screws can be used to hold the speaker in position, but if the front of the cabinet is only 3-16in plywood as in our case, it may be difficult to get them to hold properly. We found that a better idea is to use countersunk 1-8in bolts. Drill 3-32in holes right through the wood in the required positions and countersink them on the outside. (If you don't have a special countersink, a ¼ or 3-8in drill will serve just as well.) The screw can then be started quite easily from the outside and will make its own thread. Make sure that it is screwed tightly so that there is no chance of it working loose after the cabinet is covered.

PARTS LIST

- 1 Cabinet 7½in x 5½in x 3⅞in (inside).
- 1 Chassis 5¾in x 3¾in x 2¼in.
- 1 Midget 2 gang with vernier drive
- 1 Scale for above.
- 1 100 pf variable condenser.
- 2 1T4 valves.
- 1 3S4 valve.
- 3 7-pin miniature valve sockets.
- 4 Tag strips.
- 2 Small knobs.
- 1 Rubber grommet.
- 1 Section wound RF choke.
- 1 5" speaker with 5000 ohm transformer.
- 1 1.5 volt cell.
- 1 67.5 volt minimax battery.
- 1 2 Pole on/off switch.
- 2 8 mfd electrolytic condensers.
- 4 .02 mfd paper condensers.
- 1 .001 mfd paper or mica condenser
- 2 250 pf mica condensers.
- 1 100 pf mica condenser.
- 1 3.0 meg ½ watt resistor.
- 1 2.0 meg ½ watt resistor.
- 3 1.0 meg ½ watt resistors.
- 1 0.5 meg ½ watt resistor.
- 1 0.1 meg ½ watt resistor.
- 1 0.01 meg ½ watt resistor.
- 1 1,500 ohm ½ watt resistor.

Hook-up wire, tinned copper wire, 24 gauge B & S enam., solder lugs, solder flux, nuts and bolts, glove fasteners for 67.5 volt battery &c. Also materials for cabinet and chassis if required.

The space for the larger 1.5 volt cell is well worthwhile because the life of one of the ordinary torch cells often used for sets like this may be as low as four hours. Much better than this can be expected from the cell we suggest. Its overall dimensions are 1½ x 1½ x 4 1-8 inches, and it is provided with screw terminals.

Basically, the chassis is a unit 5¾in x 3¾in x 2¼in. A large cut-out at the front is required to accommodate the speaker and, as you will see from the photographs, some of the metal which would normally be part of the end and front of the cabinet is bent around to assist in holding the battery.

Looking from the front, the tuning condenser is mounted on the front of the chassis on the right-hand side. It is a special type made locally. The shaft includes a vernier drive giving a reduction of approx. 4 to 1. It is therefore practical to mount the tuning knob on the end of the shaft while the pointer can be mounted on the part of the shaft which rotates at the same rate as the moving plates.

The people who make the gang supply the correct pointer and the printed scale, so that there is no need to worry about these items separately.

Unfortunately, production considerations make it impractical to turn out a single section condenser with the vernier drive feature, and the two-gang is the smallest available.

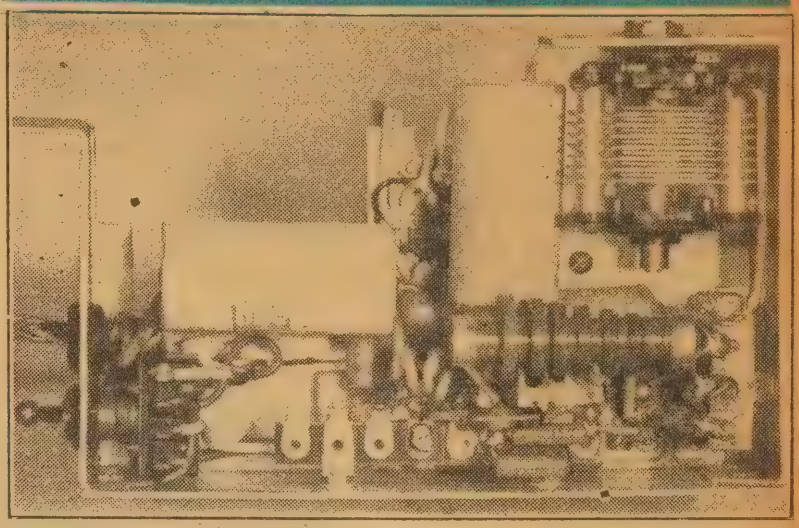
Although one section of the condenser is not used, this combination takes up less space than any other readily available single section condenser with dial mechanism. The extra section on the gang will be very handy if you decide to build a superhet later on.

Directly behind the gang is the 1T4 detector valve and alongside, near the rear of the chassis, the 1T4 voltage amplifier. The 3S4, which drives the speaker, is alongside the condenser.

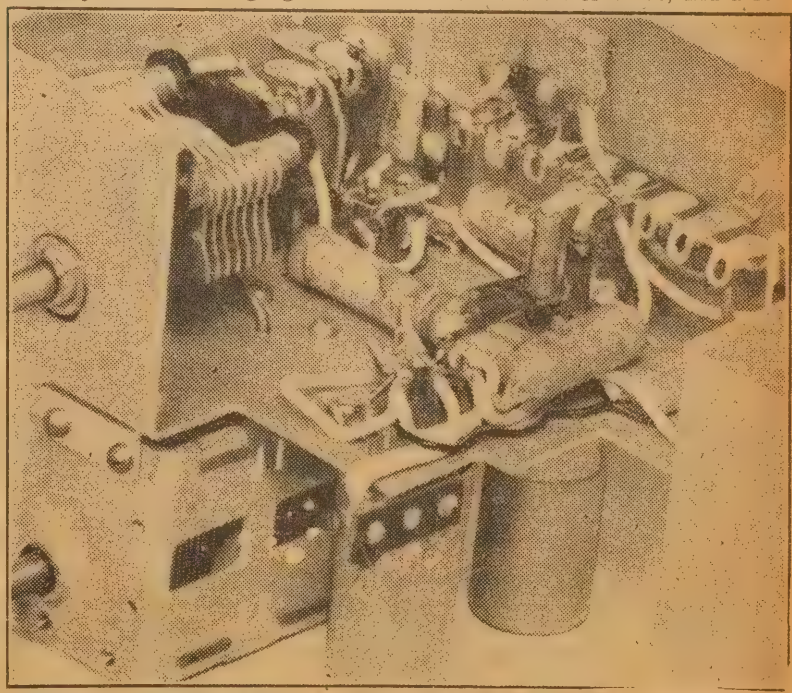
The electrical circuit is essentially the same as for last month's receiver except for the loop and the omission of the volume control. There isn't any great reserve of audio gain in this case and the reaction control serves also as a volume control.

A fair amount of care and planning is necessary in order to make a neat job of the wiring because there are a number of parts to be fitted into a small space. We found it necessary to use four tag strips in all. The connections to the loop aerial are terminated at a tag strip screwed to the inside of the cabinet above the detector valve, and a sec-

PICTURES OF UNDER CHASSIS



Underneath view of the complete wiring job. The battery leads go away to the left above the switch and the leads to the loop to the right.



Both electrolytic condensers and the RF choke have been removed in this close-up to enable you to see some of the smaller components.

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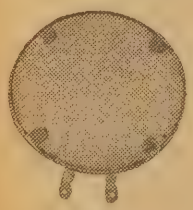

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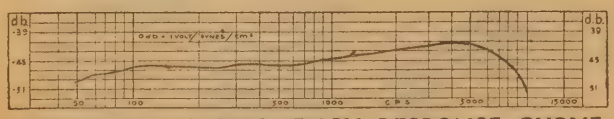

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ond tag strip terminates the loop connections inside the chassis near the detector valve.

Another tag strip is used to support a number of resistors and condensers, the RF choke and the electrolytic condensers. It is bolted to the back of the chassis. Finally a tag strip is mounted above the chassis near the 3S4 in order to secure the speaker leads.

The leads to the loop aerial can be made about 6in long and those to the speaker even longer if necessary, so that the set can be operated with the chassis out of the cabinet. any case, it is a simple matter to spot the leads in place as you place the set back in the cabinet.

DOUBLE POLE SWITCH

The on/off switch is a double pole job in order that both the filament and high tension circuits can be broken at the same time. Although the high tension current flowing in the valves is cut off automatically when the filament power is removed, the slight leakage through the electrolytic condensers would prejudice the life of the 67.5 volt battery.

The switch is mounted on the side of the chassis at the rear. It is reached through a hole cut in the back of the cabinet. This arrangement has the advantage that there is nothing projecting from the rear to get in the way when you are carrying the set.

All the details of the chassis you will require are shown in the half-size chassis plan. The holes shown for the gang mounting were designed for a pair of home-made brackets which you may prefer to use instead of the brackets supplied. They are 3-8in x 3-8in and the holes are 5-8in apart.

Many readers will decide to build their own cabinet. There is really very little to the job and the saving in expense is considerable. Another point, too, is that the loop aerial is an integral part of the cabinet and not many manufacturers will care to take on the job of winding it.

The necessary dimensions are given in the drawing. You will note that the material is 3-8in ply for the top, bottom and ends and 3-16in ply for the back and front. The thickness of the 3-8in ply helps to keep the loop away from the metal parts of the set with a worthwhile effect on the performance. For a similar reason, we suggest that a set of rubber feet be fitted to the bottom of the cabinet to keep the loop reasonably clear of any metal objects on which the set may be stood.

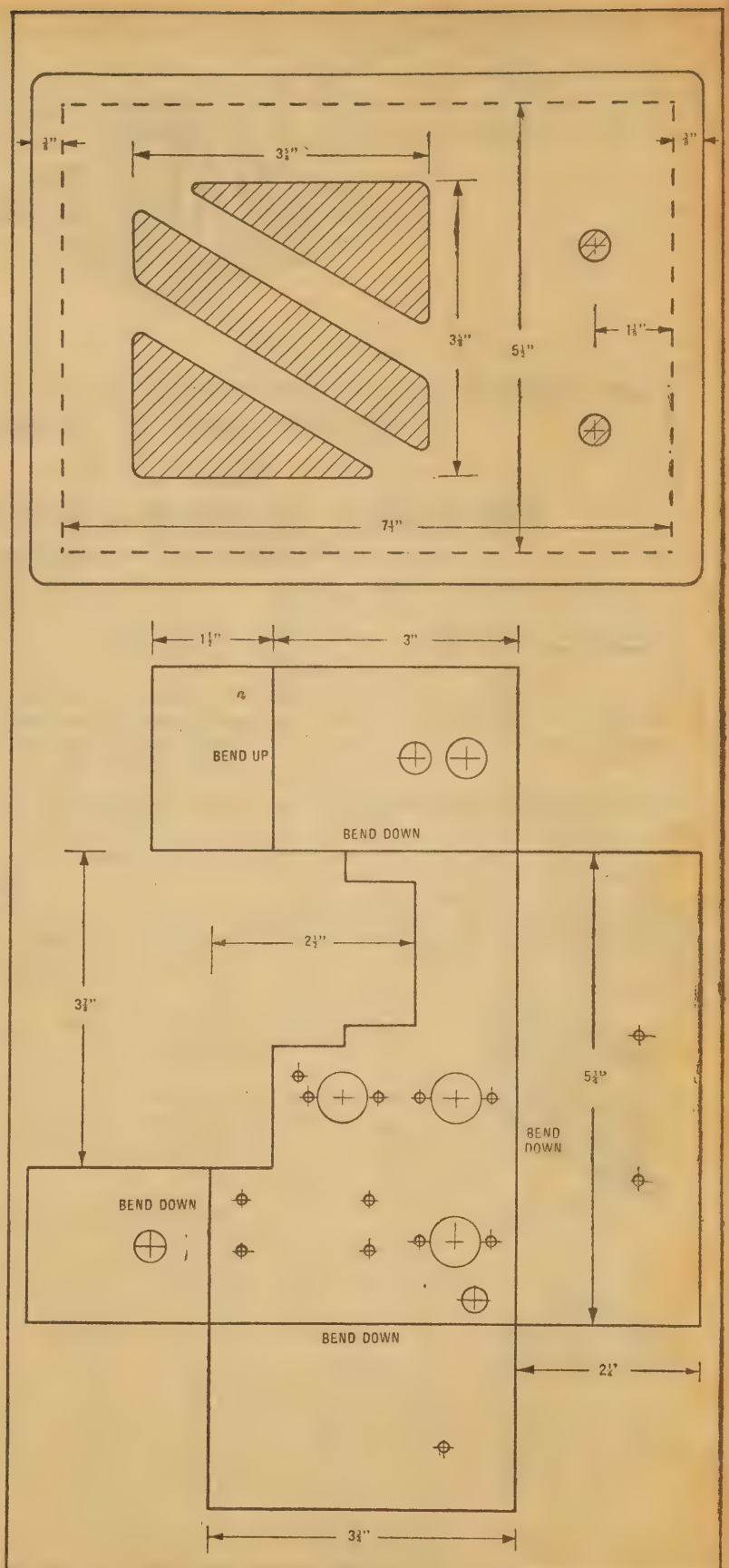
FITTING THE LOOP

A groove about 1 1-8in wide and 1-32in deep all around the cabinet is required to accommodate the loop aerial. It is possible to do the job with a sharp knife but a well-sharpened chisel about ½in wide will make the job easier.

If you wish to paint the cabinet it will be necessary to fill the space in which the loop is wound. Plastic wood would be excellent for the purpose. A better scheme, however, is to cover it with leatherette. It isn't as hard as it may sound and you will probably be very much more pleased with the results than in the case of a painted job.

Rather than give you a sketchy

(Continued on Page 55)



The information in this scale drawing will enable you to make your own chassis and cabinet. The top, bottom and ends of the cabinet are made from ⅜in ply while 3/16 ply is used for the front and back. A hole in the back is required to reach the switch. The chassis may be either aluminium or mild steel of 18 or 20 gauge.

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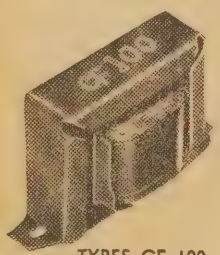

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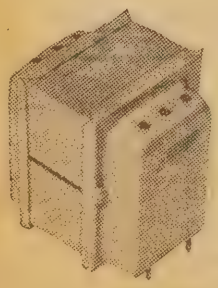

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CF 103	30H	60 M/A	420 ohm	25V	2lbs. 6ozs.
CF 104	30H	75 M/A	580 ohm	43V	3lbs.
CF 105	15H	80 M/A	250 ohm	20V	2lbs. 6ozs.
CF 106	12H	100 M/A	200 ohm	20V	2lbs. 6ozs.
CF 107	30H	100 M/A	360 ohm	20V	4lbs. 1oz.
CF 108	12H	150 M/A	135 ohm	36V	4lbs. 1oz.
CF 109	20H	150 M/A	225 ohm	34V	5lbs. 4ozs.
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FROM THE SERVICEMAN WHO TELLS

I am becoming more than ever convinced that the really difficult things in a serviceman's life are not radio sets at all — but the people who own them. This last month I have had to teach one owner how to operate his set, try to interpret what another meant by "noise," and de. with an obvious "difficult" type.

REMEMBER the old schoolboy gag about "When is a door not a door"? Well, I feel tempted to set out my first case this month in much the same manner, because that was my reaction immediately I had sized up the situation. As a result, I would suggest that the technical version of the gag would go something like this:

Question: When is a knob not a knob?

Answer: When it's a tone control.

Explanation: Very few listeners seem to be capable of using this control intelligently or, in fact, are even aware that it exists.

And what started this train of thought?

WEAK AND DISTORTED

A customer who complained that his set was performing very poorly, having insufficient volume and being, as he expressed it, "muffled."

It happened to be convenient to give the set a preliminary check in the customer's home, where he proceeded to demonstrate just how bad it really was.

As the set warmed up, I realised that he had not exaggerated, but rather, if anything, had understated the case. The reproduction, in addition to being typical Wooftaphone quality, had a distinct overload characteristic and the net result was a deep, distorted, mumbling sound — actually a news session—which could only be followed with extreme concentration.

"And that's with the volume well up," said the owner, indicating the appropriate knob. The complete absence of any signals above about 1500 cps made me reach instinctively for the tone control and, as I moved it to the "treble" position, not only did the high notes appear, but the volume came up with a rush. When this had been reduced to normal again and the tuning adjusted accurately—a process which was almost impossible before, due to the absence of audible sidebands—the indistinct mumbling had become a human voice, reasonably clear and intelligible.

BLACK MAGIC?

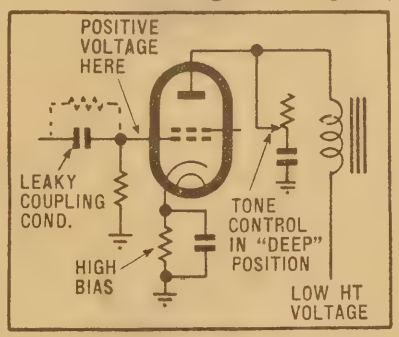
This rather rapid transformation in the set's performance achieved by simply twisting a few knobs, was regarded by the owner as something akin to black magic, and he was obviously beginning to wonder whether he had called me in simply to show him how to tune the set. In a sense, this was true, but I thought it more tactful not to labor the point, and set about piecing together the full story.

The first point which was clearly obvious was that the tone control was a particularly vicious one and in its deepest position brought about a considerable reduction in volume. It was almost equally obvious that it had occupied its present setting for a long time, probably ever since the salesman had set it there to impress his customers with the receiver's beautiful "mellow tone." (Horrible expression!)

NEGLECTED CONTROLS

The owner, and his family, had apparently accepted this reproduction as perfectly normal and, in time, had become quite used to it. The tone control knob, together with its companion, the wave change knob, were regarded as mere ornaments and the only knobs which were ever used were the tuning and volume controls. (What price the extra cost of a dual wave set?)

This had worked tolerably well for a while because, in spite of losses brought about by the tone control, there was a margin of volume over and above that required for normal room listening. Now, however, something had happened to remove that margin, so that the set had to be forced into the distortion region in order to provide sufficient volume and it was this distortion, coupled with the lack of high note response,



A combination of reduced power output and excessive tone control caused poor performance in this set. The reduced power was caused by a leaky coupling condenser, while a little instruction was necessary to help the owner use the control correctly.

which had made the reproduction so intolerable.

By eliminating the tone control losses I had provided sufficient power to permit normal room listening without distortion, at the same time demonstrating to the owner that he didn't HAVE to put up with such woolly reproduction unless he wanted to; and I gathered that he didn't particularly want to.

As far as the owner was concerned, the story could well have ended there because he was now perfectly happy with the performance, particularly since he had discovered the extra feature hidden behind the previously unused knob. However, valuable though this discovery may have been to the owner, it was clear that more than this was involved because something had obviously happened to limit the available power output.

Advancing the volume control showed that distortion commenced not far above the normal listening level, whereas there should have been considerable margin, and it was fairly certain that ultimate failure was only a matter of time. I pointed this out to the owner and advised him to have the matter rectified, even though the set now appeared to be working correctly. He readily agreed and I took the set back to the shop for a complete overhaul.

Before commencing work on it, I ticked off mentally the three most likely causes of the distortion: (1) weak or gassy rectifier valve, (2) weak power valve, or (3) a leaky coupling condenser.

Since there was no blue glow in the rectifier I discarded the gas theory and commenced a detailed check with a measurement of the HT voltage. This was a little lower than I had expected, though not sufficiently so in itself to cause the trouble, and I discarded the weak rectifier theory.

Next I measured the self bias on the power valve and, finding it rather higher than usual, decided that a weak power valve was far less likely than the old story of a leaky coupling condenser.

POSITIVE GRID

A measurement from the power valve grid to chassis showed a slight but quite unmistakable positive deflection, and this vanished when the coupling condenser was disconnected. No further evidence was really necessary, but I checked the HT voltage and the bias voltage again and found, as I expected, that the former had risen and the latter had dropped, both being now more nearly the value I had originally expected.

Although the coupling condenser was leaky it was not a bad case and the leakage could only just be detected on the high ohms range of the multimeter. This meant that it was well above the one megohm mark, though this is still enough to upset the operating conditions of the output valve to the point where the undistorted output was seriously limited.

On the other hand, it was not as bad as the usual fault of this kind, which frequently cancels the bias, producing intolerable distortion at all levels and, generally, ruining the valve if allowed to persist for any length of time.

In this case, however, it appeared that the valve had survived the

creating sound impressions

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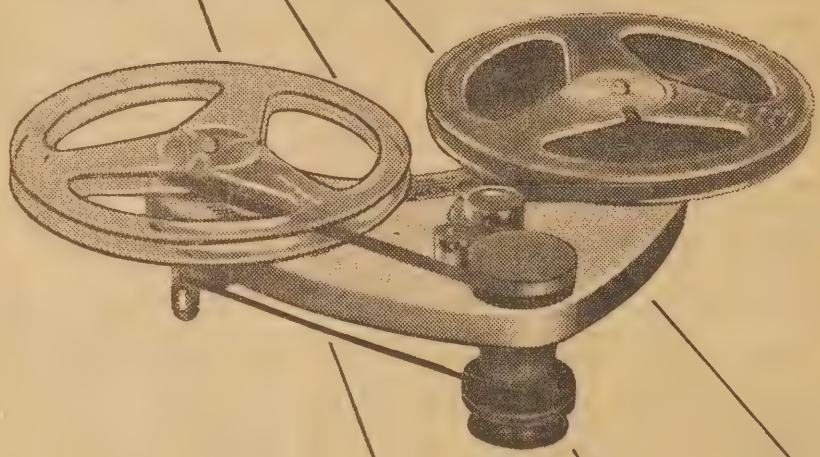

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ordeal, since it tested "good" and behaved in a perfectly normal manner in the set. Thus, I could see little justification in replacing it, though I advised the owner that it might give trouble at a later date and that, at the first sign of distortion, it would be as well to have it checked.

And so I left him to twiddle the newly-discovered knob.

Another case I had this month provides an excellent example of how careful the serviceman must be to avoid jumping to erroneous conclusions, particularly when the only symptoms available are the observations of a non-technical owner who is only able to give the vaguest description of the trouble.

The set was a five-valve mantel model and the owner complained that it had been giving forth loud "noises." Knowing that the area in which it was operating was rather notorious for electrical interference, I decided to check it on location first in order to eliminate, if possible, the risk of chasing a fault, in my own workshop, which was purely one of location.

NO SYMPTOMS

As is so often the case, the set flatly refused to exhibit any symtoms while I was present and I could only judge the nature of the interference from the owner's rather non-technical description that it took the form of severe "blurps" at irregular intervals.

It sounded to me very much like electrical interference but, as the owner was keen to have it overhauled anyway, I decided to do this first and then, if the noise did not show up, to make further investigations on location.

Accordingly I brought it back to the shop, set it up on an unused corner of the bench, and let it run while I continued with more routine jobs. After operating it in this manner for a whole day, with no sign of trouble, I was just about convinced that the fault was, in fact, one of location, but decided to try coaxing the set into misbehaving if possible.

I removed it from the cabinet, turned it upside down on the bench, and commenced to gently prod each component. Nothing happened until I reached the area around the power valve when, on tapping the chassis, the speaker gave forth a terrific "blurp." It sounded just as if the set had suddenly gone into violent audio oscillation, complete with a full set of harmonics.

Anyway, whatever the cause, it now seemed certain that this was the noise which the owner had described and that it really was the fault of the set.

Next point was to find which component was intermittent, and this called for some careful probing. The difficulty is that any mechanical vibration, as, for example, tapping a component with an alignment tool, is quite efficiently transferred to many other parts of the chassis, so that a response when a particular component is struck does not necessarily indicate that the particular component is to blame.

To assist in locating the real culprit—and to avoid being side-tracked—it is necessary to develop a very definite technique. Having first located a component or part of the chassis which is sensitive to vibration, one should then check other components nearby, using, as nearly as possible, the same tapping force.

It will probably be found that they, too, will be sensitive, but will become less so as one progresses further afield. In this way the general area in which the faulty component lies can be quickly determined, but the important point to remember is that the tapping must be consistent in order to localise the area correctly.

Next step is to tap each of the suspected components in turn with decreasing force, eliminating each one as it fails to respond, until a stage is reached where only a very light tap is required to affect one or two components which, naturally, are most likely to be the culprits.

I know that all the foregoing may sound rather complicated, but it really isn't, and only needs a little practice to develop into a routine which one follows automatically.

In this case the routine led me to the general area of the power valve socket and then to a .01 condenser, serving as a top cut filter from the 6V6 plate to chassis. As a final test I applied steady pressure to the condenser and this also gave an indication. The advantage of a pressure test is that it is not nearly so likely to affect nearby components, and is thus a far more definite indication.

Just why the failure of this component should cause the set to oscillate, as it appeared to be doing, was not quite clear, though I suspected that the output valve may have had a natural tendency to oscillate and the presence of the top cut condenser was all that was keeping it stable. Thus I quite expected the set to became hopelessly unstable when I removed the suspected condenser but this was not so, the only effect being the slight change in level of the high notes.

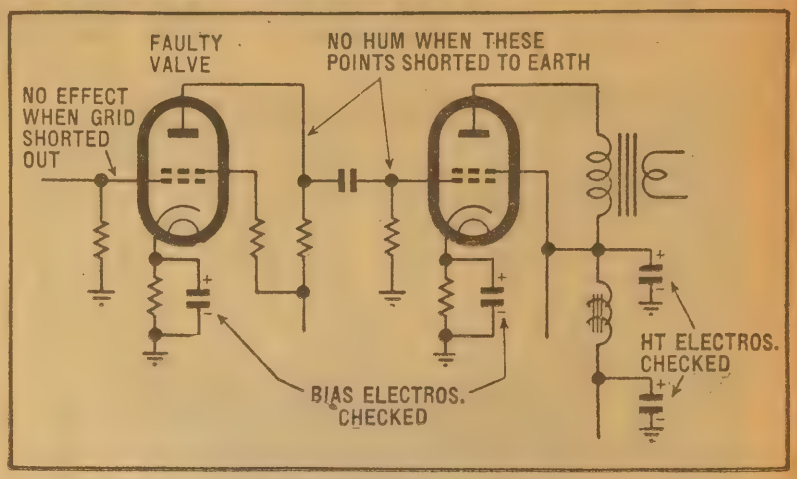
More careful examination of the condenser, now that it had been removed, showed that it had a loose pigtail, while a check on the capacity bridge confirmed that this was intermittent. Well, at least the cause of the trouble had been found, but I was still at a loss to explain why this had created such a terrific racket, instead of merely altering the balance of reproduction.

ANY SUGGESTIONS?

In an attempt to re-create the condition I connected a new condenser in circuit, making the earth connection permanent, but leaving the plate connection free, so that the intermittent condition could be repeated. Sure enough, I found that I could produce the same healthy blurps by touching the pigtail on the 6V6 plate pin, but that they only occurred at the moment of making or breaking the connection.

A complete explanation of the phenomenon still eludes me, but I suspect that the audio system as a whole was inclined to instability and, although quite stable with the condenser either present or removed, was shocked into momentary oscillation by the surge created when

PUZZLE — WHAT CAUSED THE HUM?


FAULTY VALVE
NO HUM WHEN THESE POINTS SHORTED TO EARTH
NO EFFECT WHEN GRID SHORTED OUT
HT ELECTROS. CHECKED
BIAS ELECTROS. CHECKED

Showing the various points which were tested when tracking down a rather strange hum. Although obviously caused by a valve the exact nature of the defect could not be traced and must remain an unsolved mystery.

AT regular intervals every work bench becomes so cluttered with tools, odds and ends, relics of past jobs, &c., that the task of clearing it for a fresh start cannot be put off any longer. But how do you set about this job. If you tackle it in a hit and miss manner it is probable that you regard it as one of those "nasty" jobs and put it off as long as possible. Suppose you try it this way next time.

Mentally divide the bench in half and decide that, say, the left side is to be cleared first. Take each item from this side and, if it is one of those things that you are not sure what to do with for the moment, place it on the right side. At the same time tools are placed in their racks and obvious rubbish (it's amazing how much accumulates) is discarded.

In a surprisingly short time the left side will be clear enough to brush down (keep an eye open for small nuts, washers, &c.) after which the items on the right side may be tackled, once again moving the "doubtfuls" to the opposite side, sorting the tools, and discarding the rubbish. When this is finished the right side may be brushed and the only job remaining is to decide the fate of the few items left on the bench. At this stage these look far less formidable than when you started and are thus more easily classified.

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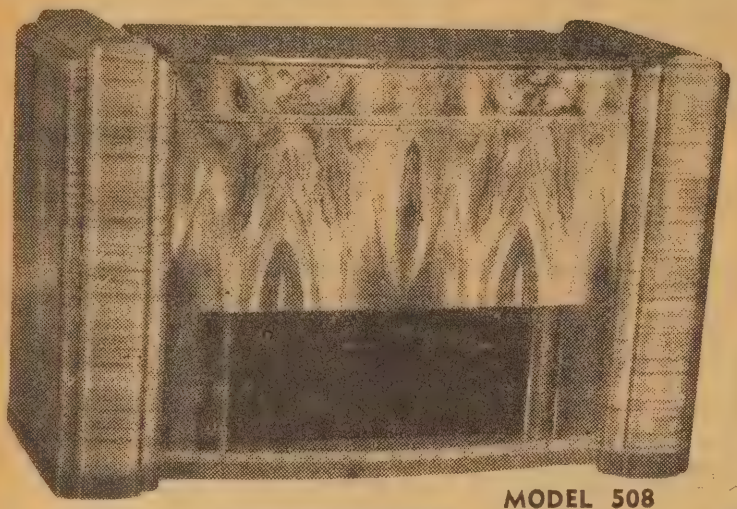

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MODEL 508

Model 508 is suitable for all types of record changers.

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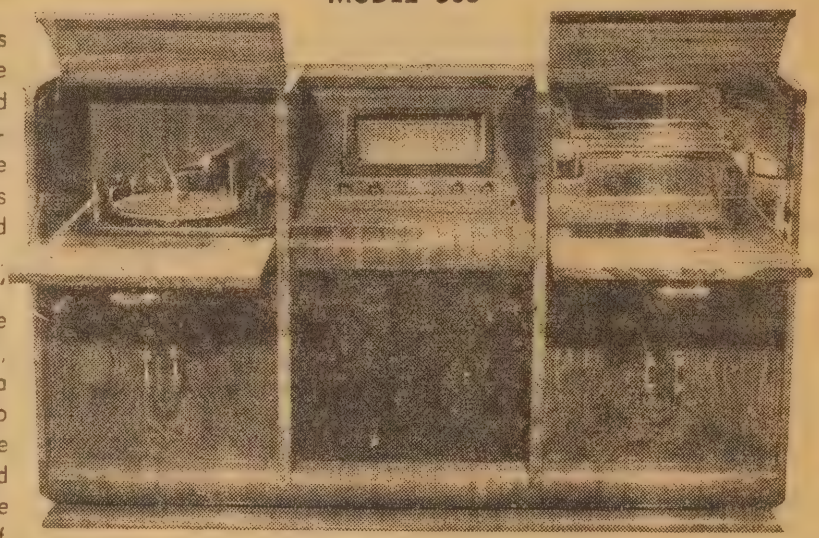

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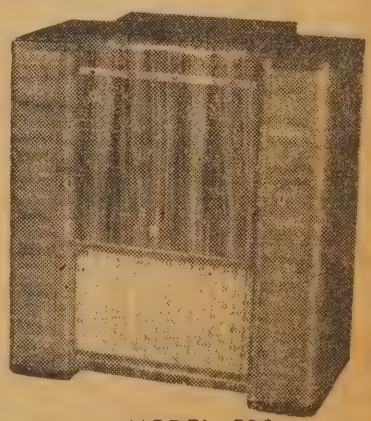

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the condenser circuit was opened or closed.

Anyway, whatever the exact cause, the fact remained that a new condenser cured the trouble, though I took the precaution of satisfying myself that the set was completely stable under all operating conditions.

Have you ever noticed how fate deliberately sets out to make a liar of you at times, particularly if the customer is inclined to be a "difficult" type?

Such a case occurred to me recently when a customer brought a set to the shop and complained that it was "motor-boating." His glib use of such a phrase, normally the exclusive property of the technically minded, may give you some idea of the type he represents; the type who imagines he knows a lot about radio and is, therefore, constantly on guard against being "done," and who automatically assumes that all servicemen are rogues and charlatans of the worst order.

I was not particularly worried about this attitude at the time, and was even less impressed when his attempted diagnosis proved false, for the so-called "motor-boating" turned out to be nothing more than a very solid hum level I certainly never imagined that such a simple fault could place me in a position where I hoped the customer would not ask too many questions.

TRACKING IT DOWN

From a purely technical angle, my first impression was that one, or, more probably, both main electrolytics had gone, but was forced to abandon this theory when a new one bridged across each in turn had no effect.

Next I checked the electrolytics across each of the bias resistors, but these also seemed to be functioning correctly, and I realised that a more systematic approach to the problem was needed.

First, I shorted the grid of the 6V6 to chassis, whereupon the hum vanished, thus indicating that it was further toward the audio input point. Shorting the plate of the 6B8 to chassis produced a similar result, but shorting the grid of the same valve had no effect.

Having thus narrowed the trouble to this particular stage, and having already checked most of the associated circuitry, I felt reasonably confident that the 6B8 itself was the culprit. This theory was quickly substantiated by substituting a known good valve, which immediately restored the set to normal operation. Just to be quite sure, I plugged the old valve back in again, and there was the hum as merry as ever.

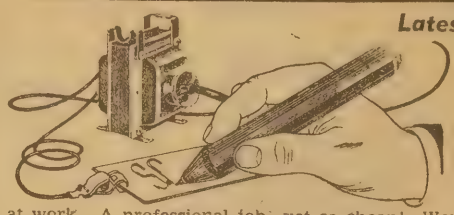
So far, everything was perfectly straightforward, and I simply plugged in a new valve, gave the set a routine check and alignment, and returned it to the customer. There was no doubt in my own mind that the trouble was due to a faulty valve—in fact, I am still prepared to stand behind the statement—but I received something of a shock when I plugged the offending valve into the tester in an effort to find out exactly why it had failed.

I had originally assumed that the trouble was probably a heater cathode short, or something of a like nature, so you can imagine my surprise when I was unable to detect any suggestion of leakage between any elements, plus the fact that the valve tested "good" and was, therefore, to all appearances a perfectly good valve.

I can only assume that the valve was either suffering from a rare defect which did not show up in the tester, or that the fault was of an intermittent nature and had temporarily cleared itself. But, whatever the cause, I am now faced with the problem of what to tell the owner if he suddenly gets an inspiration and demands that the faulty valve be returned. And he is just the type who would want it back!

He is also the type who would take it to another serviceman and have it tested, branding me as a rogue when it tested "good." The annoying part about it, of course, is that I cannot be sure that I could prove my point by putting it back in the set, because it would be just as likely to make a liar of me by turning on a first-class performance. The next time I have a set in the shop in which I can check it I'd like to do so, otherwise I would smash the darned thing!

Truly, a serviceman's lot is not a happy one.



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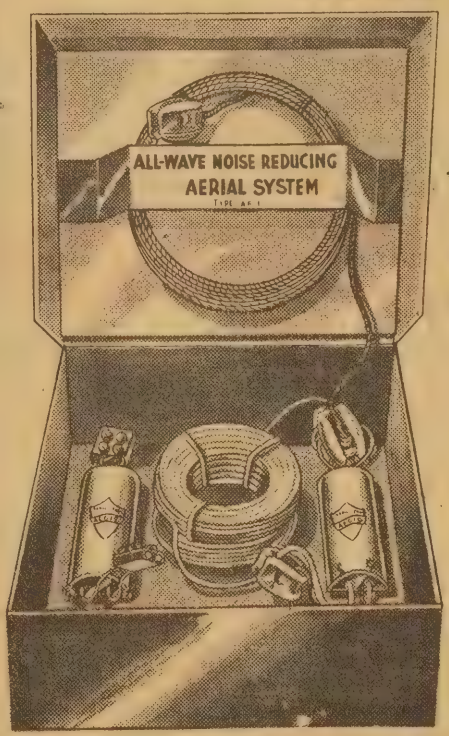

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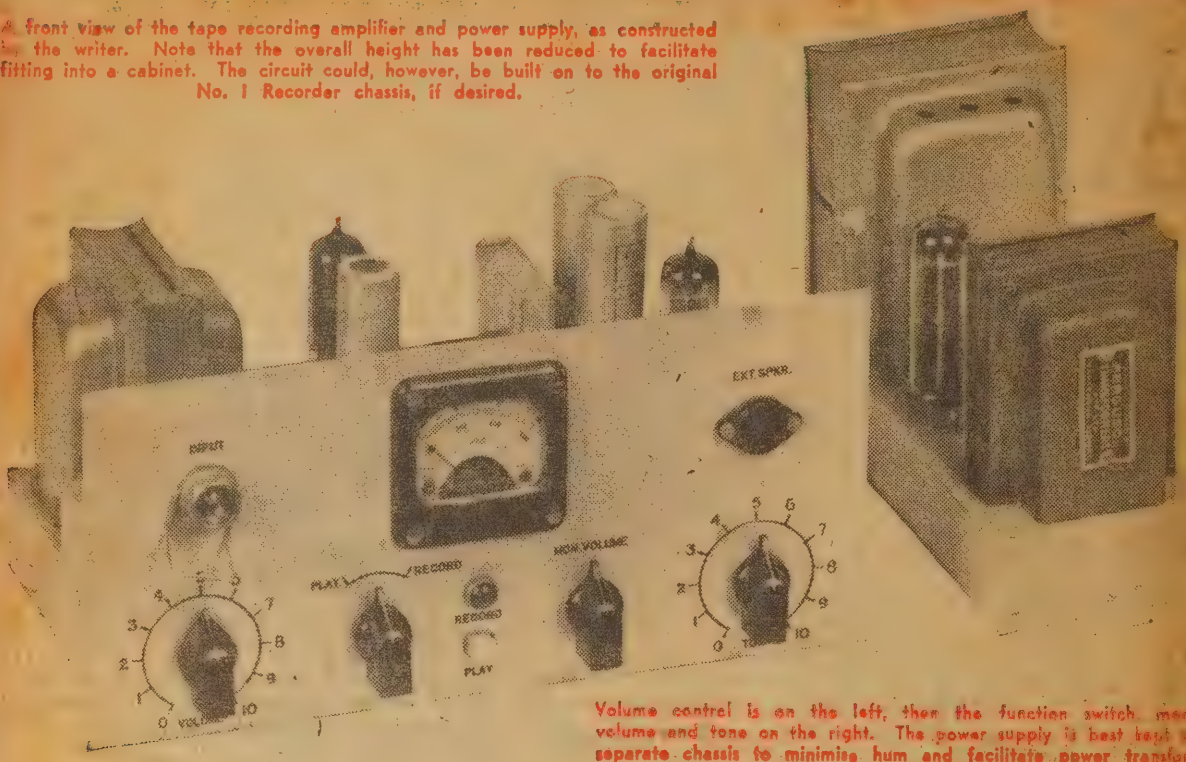
A front view of the tape recording amplifier and power supply, as constructed by the writer. Note that the overall height has been reduced to facilitate fitting into a cabinet. The circuit could, however, be built on to the original No. 1 Recorder chassis, if desired.



Volume control is on the left, then the function switch, mixer volume and tone on the right. The power supply is best kept to a separate chassis to minimise hum and facilitate power transformer placement.

MORE ABOUT TAPE RECORDERS

Here is some more helpful information about the design of amplifiers for tape recording and playback. The article describes the provision of a power oscillator in our No. 1 circuit and goes on to describe a new design specially suited for inclusion in conventional single unit recorders.

by W. N. Williams

IN the first instance the job of building the new amplifier was commenced as a purely personal venture, in that the writer needed something like it to use with a variety of tape decks, both home-constructed and otherwise.

COMPACT DESIGN

The amplifier had to be efficient without being too complicated, and of such an overall size that it would fit easily into some ultimate cabinet arrangement.

The original intention was to develop a circuit which would be deliberately different from the No. 1 Recorder, described in the November issue. We accordingly checked through a long list of references, as well as doping out a good few ideas of our own.

Some were dubious, others might have worked very well, but nearly all were more complicated for the results obtained than the existing circuit. In the face of this, it seemed only logical to retain the same basic arrangement.

As you might remember, this involves the provision of a fairly standard basic amplifier using two preliminary pentodes and an output valve.

Negative feedback is applied over the last two stages, being modified by switching to provide permanent bass boost, plus a rising treble response on "record" only.

In addition, the feed circuit to the head in the "record" position, contains a simple bridged-T network as well as the normal swamp resistor.

With this arrangement and a good quality head, it is entirely possible to obtain a response which is flat to within a couple of db from 40 to about 7000 cps. and with usable output up to about 10 Kc. This, for a tape speed of 7½in. per second.

One fundamental change that we did decide to make was the substitution of a higher powered oscillator to provide for high frequency erase. There is much to be said for this method, from the point of view of convenience, added to which it is the only feasible method of erase for half-track work.

With efficient circuitry, it might just be possible to obtain sufficient output from a low power twin triode, as originally specified, but the conventional approach is to use a beam power tube, offering a much greater permissible plate dissipation.

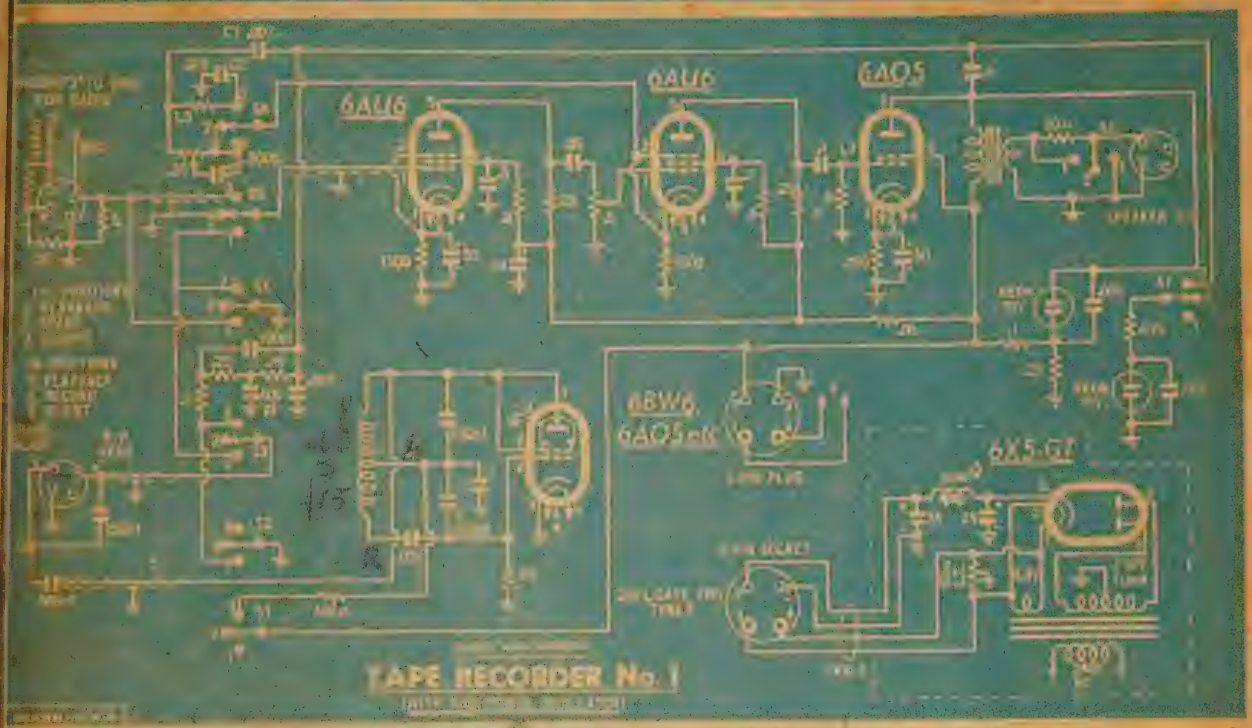
Unfortunately, it is difficult to go on from there and specify a set of component values which will never need to be modified. Oscillator circuits, unfortunately, are like that!

PARALLEL "C"

A certain minimum value of capacitance is necessary across the coil to ensure good output and waveform. Too much capacitance, however, seriously lowers the resonant frequency and a figure of 50 Kc, or thereabouts should always be aimed at. Then again, the grid condenser and capacitor profoundly affect the operation of the stage, and are likely to need modification.

The erase head, too, should ideally

No. 1. RECORDER CIRCUIT WITH POWER OSCILLATOR



This circuit is as originally published in the November issue except that a high power oscillator has been added to allow for electronic erase. Compare this with the circuit on page 51. The two are basically similar so that individual features can be interchanged to suit special requirements.

form a series-resonant circuit at the oscillator frequency with the condenser which couples it to the oscillator output.

When this condition is achieved loading on the oscillator is more nearly resistive and the erase voltage across the head will reach a higher peak value and have better waveform than that supplied by the oscillator.

The coupling condenser which ensures this maximum RF potential across the erase head is best selected with the aid of a CRO or a good quality AC voltmeter. The precise value will obviously depend both on the bias frequency and the effective inductance of the erase head.

BIAS VOLTAGE

The R.P head can conveniently receive its own bias from this "tuned" source. The order of bias voltage, as determined by the supply condenser, should approximate by test, the figure which produces the highest signal level on the tape.

We have followed the only possible course of specifying component values which happen to suit a typical combination of oscillator coil and half-track heads. They happen to be fairly "safe" values and should work with most average components.

You should be prepared, however, to experiment along the lines indicated for optimum results or to accept the advice of manufacturers who may recommend another set of values.

By way of example, we tested the recorder with the deck pictured in the November issue, and using only a single, tapped recording head. For optimum bias conditions, we had to feed the output from the oscillator via a 500 pf. condenser to the r/p head, omitting the 250 pf. condenser altogether.

Two other points about the oscillator warrant special comment. Switch contacts nominated as S1 have been connected in the HT feed circuit instead of the cathode return. The 400 ohm resistor and the 0.1 mfd. bypass serve both as an RF filter and as a delay medium to slow the build-up and decay of the RF envelope.

A second point is that, when supplying an erase head, the oscillator might draw upwards of 20 milliamps, as compared with 4 or 5 milliamps for the original twin triode bias oscillator. The extra drain should normally be within the capacity of an 80 milliamp transformer, but the point should be borne in mind if you happen already to be feeding a lot of milliamps into an external load.

To round off all this discussion, we are reproducing, as the first diagram, the circuit of the Radio and Hobbies "Tape Recorder No. 1," as it would appear with a conventional beam power oscillator. The circuit should assist those who may have endeavored already to adapt the design for electronic erase and/or half-track work.

OTHER CHANGES

In actual fact, the amplifier pictured at the head of the article includes still further modifications, which are mostly aimed at facilitating its use in a conventional single unit tape recorder.

These additional modifications are sufficiently important to warrant further discussion and a separate circuit diagram which we have branded for identification as the Radio and Hobbies "Tape Recorder No. 2."

The first point is relatively minor in that we have substituted a single shielded microphone plug for the multiple input arrangement shown in the original circuit. This is purely a personal preference and may be varied to suit individual requirements. As it is, the microphone may be plugged in directly, or connection made alternatively to external pads or to a complete external mixing panel.

More significant is the choice of a different type of preamplifier valve —the 6BR7.

MICROPHONY PROBLEM

Type 6AU6, as originally specified, is capable of extremely high stage gain, but, in common with other high Gm pentodes, it is rather prone to microphonic effects. While this was of no great consequence in the original circuit, it could easily lead to trouble in an amplifier which might have to be housed in the same cabinet as the loudspeaker. A non-microphonic type was clearly to be preferred.

Quite a few low noise pentodes are listed, but nearly all of them approximate the electrical characteristics of the familiar 6J7, and therefore offer only about half the stage gain of the 6AU6. A simple substitution of types would therefore leave little margin of gain for half-track work.

Examination of the circuit showed, however, that the loss could be offset quite simply by using a high slope output valve in place of the 6AQ5. We chose the 6BV7 for the one reason that it was shorter than the alternative type 6M5. Actually, the latter could be used without change to the circuit.

By changing to a high slope output

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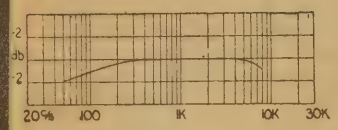
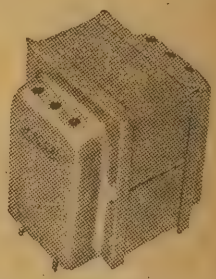


Code No	Watts	PRIM. Z.	SEC. Z.	Retail Price
OP-1	10	5000, 2500 SE	12.5, 8, 2.3	64/3
OP-1A	10	5000, 2500 SE	500	64/3
OP-2	15	5000 PP	12:5, 8, 2.3	99/1
OP-3	15	6600 PP	12.5, 8, 2.3	99/1
OP-4	15	10000 PP	12.5, 8, 2.3	99/1
OP-11	25	6600 PP	500, 250, 125	119/7
OP-12	25	10000 PP	500, 250, 125	119/7
OP-15	32	6600 PP	500, 250, 125	144/11
OP-16	32	10000 PP	500, 250, 125	144/11
OP-37	80	6400 PP	500 250. 125	207/-



MEDIUM FIDELITY RANGE
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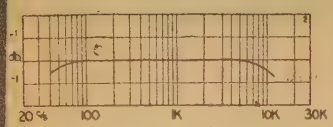
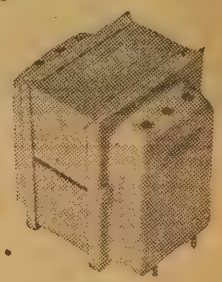


Code No.	Watts	PRIM. Z.	SEC. Z.	Retail Price
OP-112	6	10000 PP	2	92/-
OP-113	6	5000 SE	2	92/-
OP-117	6	5000 PP	2	92/-
OP-118	6	8000 PP	2	92/-
OP-119	6	6600 PP	2	92/-
OP-183	6	7000 SE	15, 2	130/10



HIGH FIDELITY RANGE
30-15000 C/S ± 1 dB

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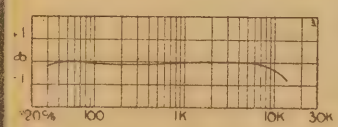
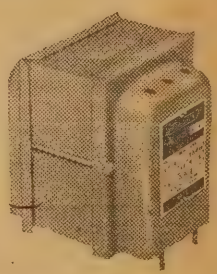


Code No.	Watts	PRIM. Z.	SEC. Z.	Retail Price
OP-22	10	3250 SE	500, 125, 2.3	101/2
OP-23	10	3250 SE	12.5, 8, 4, 2.1	101/2
OP-19A	15	5000 PP	12.5, 8, 2.3	147/2
OP-19B	15	5000 PP	500, 250, 125	147/2
OP-21	15	8000 PP	500, 250, 125	116/11
OP-62	15	10000 PP	500, 125	152/11
OP-63	15	10000 PP	15, 3.75	152/11
OP-64	15	10000 PP	12.5, 3.125	152/11
O-65	15	10000 PP	8.4, 2.1	152/11
OP-51	20	4500 PP	15, 12.5, 8.4, 6.5, 3.4, 2.7, 2.3, 2	134/4



SPECIAL HI-FI RANGE
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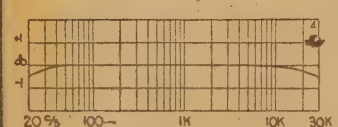
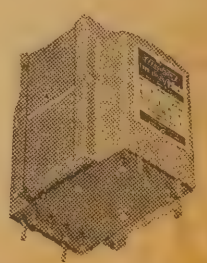
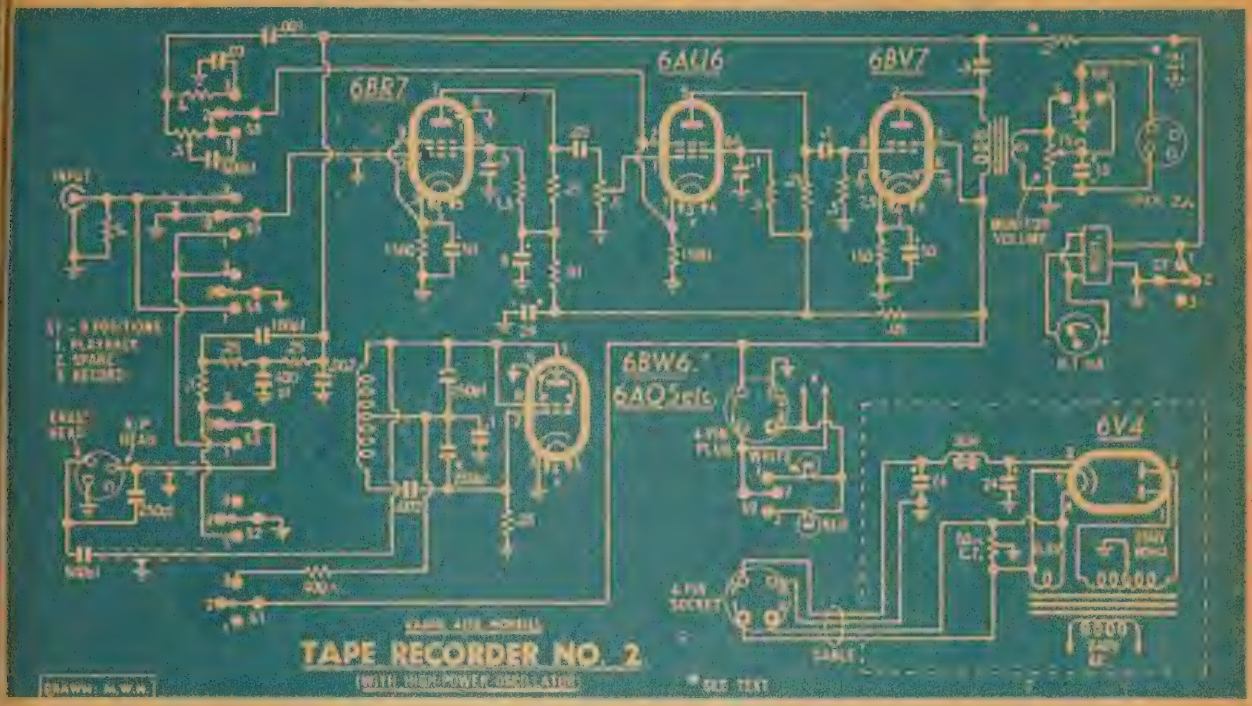


Code No	Watts	PRIM. Z.	SEC. Z.	Retail Price
OP25/500	15	10000 PP	500, 125	180/11
OP25/250	15	10000 PP	250, 62.5	180/11
OP25/40	15	10000 PP	40, 10	180/11
OP25/16	15	10000 PP	16, 4	180/11
OP25/15	15	10000 PP	15, 3.75	180/11
OP25/12	15	10000 PP	12, 3	180/11
OP25/10	15	10000 PP	10, 2.5	180/11
OP25/8.4	15	10000 PP	8.4, 2.1	180/11
OP-66	15	5000 PP	8.4, 3.7	192/5
OP-67	15	5000 PP	15, 6.5	192/5



Ferguson Transformers Pty. Ltd., Ferguson Lane, Chatswood—Phone JA2878. Available from retailers in every State.

NEW CIRCUIT CONTAINS INTERESTING FEATURES



The complete circuit of the amplifier pictured on page 48. Special features include low noise preamplifier, signal level meter, monitor volume control, electronic erase and a single record/playback control. A wide range output transformer is desirable but not essential.

valve and suitably modifying the feedback network, the same feedback factor and frequency law can be retained with the difference that the input to the volume control for full output is halved. This offsets almost exactly the loss in gain of the pre-amplifier.

As it is, input to the volume control for full output approximates 0.5 volt, which is just about ideal, should you wish to jack into the volume control circuit for a "high level" channel.

Input to the microphone jack for full output is approximately 40 millivolts, which is about the same as the original circuit. It works out in practice that, using a typical crystal microphone and half-track heads, the appropriate volume control setting for both "record" and "playback" is about half on.

With a full track head a slightly lower setting is adequate for both functions.

MONITOR VOLUME

At the speaker end of the circuit we have followed the style already set in the "Tape Adaptor." Switch function S8 has been combined in the main record/playback switch and is so wired that the speaker is connected normally for playback or to a "monitor volume" control for recording.

This latter control is a wire-wound potentiometer, which allows the speaker to be set anywhere between full-on and full-off during recording. In most cases, you will find that this control, too, can be left somewhere about mid-position for radio or pick-up work, being turned right off when using a nearby microphone.

You will note that a 10 mfd. electrolytic condenser is wired between the potentiometer tapping and earth. Purpose of this condenser is to "de-emphasise" the treble response and give a more nearly true reproduction from the monitor speaker. However, it is advisable to avoid recording with the monitor speaker full-on.

Another important modification is the substitution of a level indicator meter for the twin neons in the original design.

The meter needs to be a sensitive type and a 1-milliamp movement is the obvious choice. If it happens to be specially damped as a level indicator, so much the better.

The rectifier should ideally be a 1 to 5-milliamp meter rectifier, but we were able quite successfully to use one of the smaller telephone type

PARTS LIST

- 1 Panel 10¼" x 4-7 8".
- 1 Chassis 9½" x 5½" x 2¼".
- 1 Output transformer (7000 ohms to voice coil).
- 1 4-pole, 3-position, 3-deck switch. (3-pole sections will suffice).
- 1 1-milliamp, 2" meter.
- 1 Meter rectifier to suit.
- 1 Microphone plug and socket.
- 2 Miniature 4-pin sockets with plugs, 1 7-pin miniature valve socket with shield, 3 Noval valve sockets.
- 1 Bias oscillator coil for 6BW6 or similar valve.

VALVES

1 6BR7, 1 6AU6, 1 6BV7, 1 6BW6.

RESISTORS

1 5 meg. ½w, 1 3 meg. ½w, 1 1.5 meg. ½w, 2 0.5 meg. ½w, 4 0.25 meg. ½w, 1 0.2 meg ½w. 1 0.1 meg. ½w, 1 .05 meg. ½w, 1 .01 meg. ½w, 2 1500 ohm 1w, 1 400 ohm 3w, 1 150 ohm 3w, 2 0.5 meg. potentiometers, 1 75 ohm potentiometer.

CONDENSERS

2 50 mfd .40PV electrolytics, 1 24 mfd. 350PV electro, 1 8 mfd. 350PV electro, 1 10 mfd. 40PV, electro,, 2 0.5 mfd. 350WV., 2 0.1 mfd. 350WV, 1 .05 mfd. 350WV, 1 .03 mfd. 350WV, 2 .002 mfd. mica, 1 .001 mfd. 1 500pF. mica, 1 400pF. mica, 3 250pF. mica, 1 100pF. mica.

SUNDRIES

- 1 4pin plug & socket (6-pin if extra circuits required).
- 4 Pointer knobs, 1 6-tag, 2 5-tag, 3 3-tag mounting strips.
- 2 dial lamps with red and green bezels and lamp holders, hookup wire, spaghetti, shielded wire, solder lugs, solder, nuts, bolts &c.,

POWER SUPPLY

- 1 Chassis 8½" x 4" x 1¼".
- 1 Power transformer (preferably low flux or shielded type), 250 to 285 volts per side at 80mA., 6.3V. 2A., 5V. 2A. (optional).
- 1 20 or 30H. 80mA. filter choke.
- 2 24 mfd. 350PV electrolytics.
- 1 6V4, 1 noval socket, 1 50 ohm CT WW resistor, 3-core power flex and 3-pin plug.

Goldring

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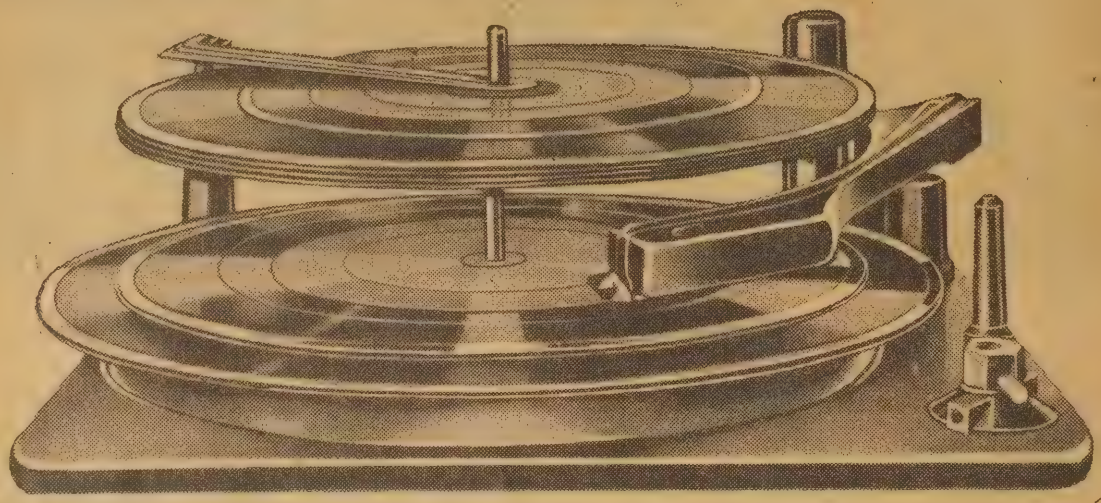
NEW! UNIQUE!

Amazing in Quality and Performance!



BSR

AUTOMATIC RECORD CHANGER

★ Discriminating listeners and manufacturers alike have acclaimed the new "B.S.R." auto-changer. Its unusual new features, its ease and simplicity of operation and its high standard of reproduction and performance have proved it a masterpiece in design and technical excellence

NOTE THESE 8-STAR FEATURES:

★ Automatically selects and plays 7in, 10in, and 12in records, intermixed, at 33 1-3, 45 or 78 r.p.m. Capacity, 10 records.

★ New record change mechanism virtually eliminates pause between records.

★ New reversible dual stylus crystal pick-up has extended frequency range to 10,000 c.p.s. Self compensated for the L.P. lower frequencies with the Turnover frequency at the correct point.

★ Pick-up automatically returned to rest position and motor switched off after last record.

★ Remarkably compact design makes it an ideal unit for any style of Radiogram combination.

★ Simplicity of design guarantees long life and trouble-free operation.

★ Beautiful styling and finish that will harmonise with any cabinet design.

★ Operates on 100/125-200/250 volts, 50 cycles A.C. Models also available for 60 cycles A.C.

RETAIL PRICE

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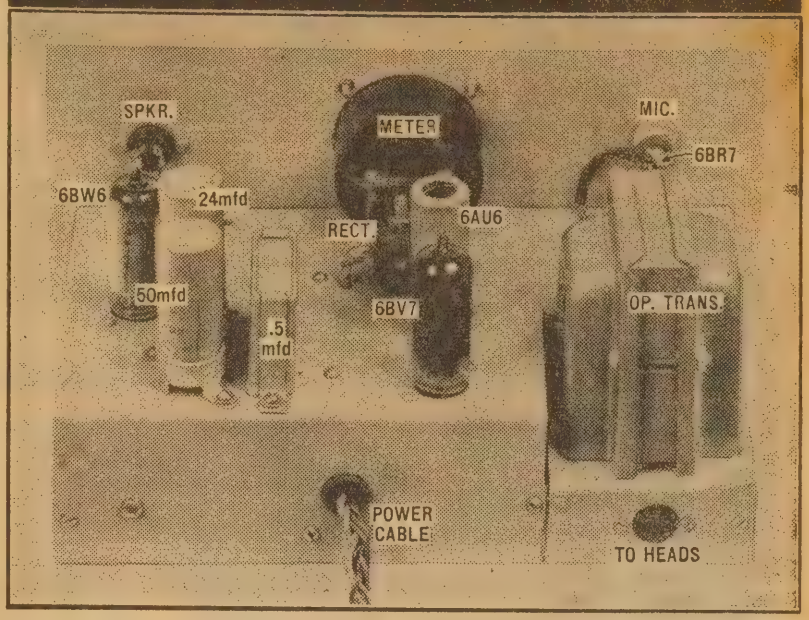
57 H.E. AREA, ST. MARYS, N.S.W.

rectifiers, thus saving quite a few shillings.

The series resistor between the output plate and the rectifier can be adjusted to give a suitable deflection on the meter at the optimum recording level. We found 0.2 meg. to be about right, but much will depend on the type of rectifier used.

Meter rectifiers, with their good high frequency response, will show up the treble pre-emphasis and therefore give exaggerated output readings on high signal frequencies. This tendency can be corrected by adding a suitable bypass in parallel with the rectifier input. No bypass was found necessary with the telephone type rectifier, which was shown by test

REAR AND UNDERNEATH VIEWS



A rear view of the chassis showing the position of all major components. Some "trick" metalwork allows the output transformer to sink below chassis level to reduce overall height.

to have just about the right amount of treble loss.

We wired one section of the record/playback switch to short the meter during the playback, as there did not seem to be any point in having the needle thresh about to no purpose. However, you can please yourself on this score.

Also optional, but handy, are the two indicator lights which operate from the main function switch — red for "record" and white for "playback."

Though shown wired to the 6.3 volt winding, we actually operated ours from the spare 5.0 volt winding. This can be expected to conserve globes while it also allowed one side of the circuit and therefore the switch wiper to operate at earth potential.

Obviously, the less 50-cycle around the switch, the better.

The remaining difference in the circuit is a minor one, namely the using of a 6V4 rectifier, which has a somewhat higher rating than either the 6X5-GT or the 6X4.

THE LAYOUT

On the physical side, the new amplifier could be built quite conveniently on the original chassis and there may be no purpose in departing from it. However, a few points about the revised layout may be of interest to those who like to do their own metalwork.

The amplifier was built on a chassis measuring 9½ x 5½ x 2½in — much the same as the original. However, by some torturous bending, one corner was bent inwards to carry the wide-range output transformer. By this means, we were able to restrict the maximum height to just under 4 5-8 inches, making the unit simpler to mount under a deck.

Manufacturers may not be too happy about making this double bend, although it would not be necessary if height is no object or if a less pretentious output transformer were used.

The position of the remaining components above the chassis is shown in the photograph.

Panel size, by the way, is 10½ x 4 7-8.

Underneath the chassis the layout worked out particularly well.

The entire preamplifier wiring fits into one front corner with the grid lead from the switch no more than a fraction of an inch long and the plate output connecting straight up to the volume control.

From the volume control the signal runs through a shielded wire back to the 6AU6 grid, then to the output valve immediately behind it.

The output plate lead runs along the rear of the chassis, in one direction to the output transformer and in the other to the output coupling condenser. From here it runs forward toward the tone control, monitor and bridged-T circuits, all of them well clear of the input.

The high frequency oscillator is tucked away in the rear corner, with an output lead run in small diameter coaxial cable along the rear of the chassis to the head connection socket.

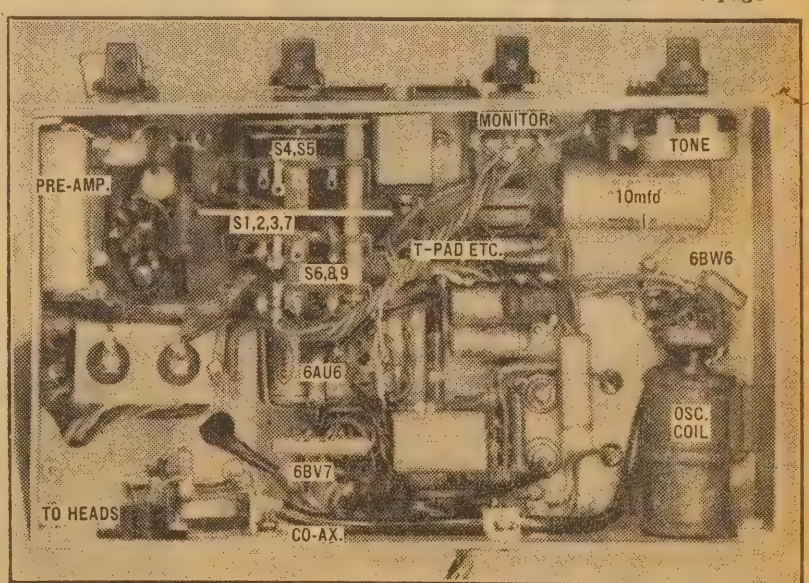
The greatest care is required in planning the wiring to the switch. We happened to have a three-position three-deck switch available, having four poles per deck, and if you can find such a switch, or have one made up, it will simplify the problem of isolating all the input and output circuits.

It is absolutely essential to shield the front section by cutting the spacers and inserting a metal plate between the decks.

As in the original design, this front section handles functions S4 and S5. The remaining contacts should preferably not be used, although, with care, you could probably use them for function S1, which should be earthy as far as RF and audio are concerned.

Actually we wired S1 to the centre bank, along with S2 and S3 (as in the original design) and also S7.

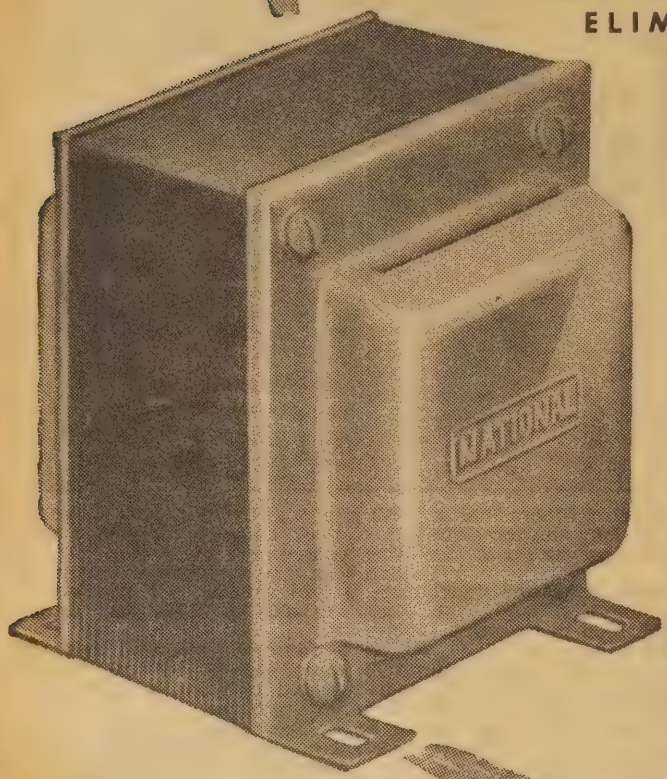
Continued on next page



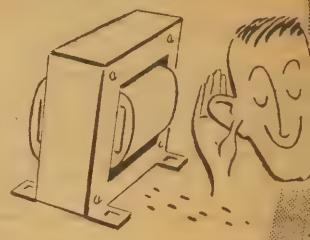
It would be difficult to identify all the components beneath the chassis but the picture does indicate the position of component groups. Layout is vitally important in an amplifier of this type, which involves bringing input and output functions to the one switch and socket.

THEY'RE QUIET . . .

LAMINATION HUM COMPLETELY ELIMINATED

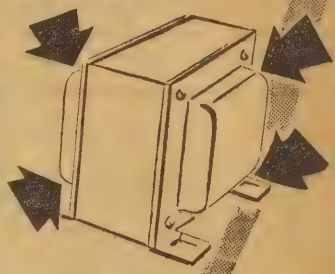


This has been achieved in types up to 50mA's by sturdy one-piece clamps of which the mounting brackets are an integral part; and, in the larger transformers by using metal covers and a one-piece clamp, both of heavy section to ensure absence of fatigue.



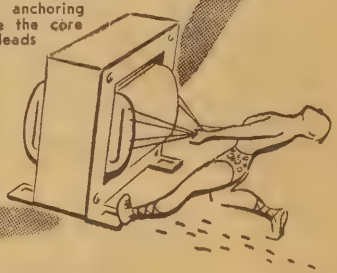
THEY'RE COOL . . .

National Power Transformers run particularly cool because of the scientifically placed cooling louvres, which are located in the top and the bottom of BOTH covers. Their presence ensures the maximum flow of air past the winding—thus minimising temperature rise.



THEY'RE TOUGH

These quality transformers are constructed on sound, robust lines. A special feature of this is the exclusive anchoring method used inside the core to prevent the leads being pulled out.

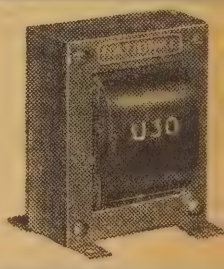


National POWER TRANSFORMERS

are available in a range of both upright and flat types to meet all requirements. Their range between 40 and 150m is without parallel anywhere. Complete details are clearly set out on page 22 of November "Radio and Hobbies," or are available from your local supplier.

NATIONAL MIDGET TRIUMPHS!

Designed for the "New Baby Mantel Receiver," the smallest receiver ever featured in "Radio & Hobbies." (See November issue). The National Midget measures 2.9/16in high, 2.3/16in wide, with 1in stack, and is ideal for miniature receivers, R.F. and Audio Oscillators, and all compact test equipment.



Please forward illustrated literature on National Power Transformers.

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Address .....

Supplier (Optional) ..... (Mar

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A NATIONAL PRODUCT FOR A NATION'S NEEDS

(Continued from previous page)

The remaining functions were performed by the rear bank.

Wiring the switch is far and away the trickiest part of the whole job, firstly because it is so easy to make a mistake and secondly because an unwise sequence of contacts might lead to trouble with instability or hum. A half-hour spent planning every connection beforehand and noting the same on paper is time well spent.

Before mounting the switch wire up as many contacts as possible and leave colored wires protruding from those which will be hard to get at later.

For the rest it is simply a matter of using the smallest available parts and planning the wiring a few steps ahead as you proceed. In our own case care of this nature paid off with trouble-free operation from the start.

The power supply needs little comment, except to say that it was constructed on a separate chassis—a highly desirable procedure—and connected to the amplifier proper by a couple of feet of cable. In a complete recorder you must be prepared to mount the power supply at some odd angle to obtain minimum hum pick-up in the head.

With this thought in mind we took the precaution of obtaining a power transformer specially designed for tape recorder work and boasting a low leakage flux field. Such transformers are available now in at least two brands.

YOUR SET AS A PORTABLE

(Continued from Page 41)

Outline of the method here, we suggest that you read the article on page 37 of the December, 1952, issue.

That about completes the story, except for a few pointers about the operation of the set.

Best results will be obtained with the loop pointed toward the required station. For maximum volume the reaction control must be adjusted so that the set is on the verge of oscillation. Always recheck the tuning, because the tuning and reaction controls are slightly interdependent.

We carried out our tests in Sydney and found that it was possible to obtain speaker reception of all locals on the loop alone. At nighttime usual reception of stations within 100 miles was also available. Because of the characteristics of the loop, sensitivity is greater toward the high frequency end of the tuning range.

For distance reception in daylight hours, an external aerial will be required and should be connected to whichever of the taps is found to give the best results. It is often a question of swapping selectivity for sensitivity, but you will find that the aerial can be connected further up the coil when tuning at the low frequency end of the range. An earth wire is essential when the external aerial is used. A short metal spike which can be pushed into the ground will serve quite well.

The discussion on the more advanced receivers which was promised for this month has been held over so that we could comply with readers' requests for the portable.

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PHOTO FLASH UNITS

"NOVA" can supply a complete range of parts for the Photoflash units described in Radio and Hobbies and other magazines. We stock: Transformers for Battery and/or 240 Volt Input, Trigger Transformer, Condenser, Reflector, Chassis, Carrying Case, Reflector-Handle, Rectifiers, Flash Tubes, &c.
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RECTIFIERS, LT 53 (Westinghouse), as above, 46/- each. Postage 2/9 each.

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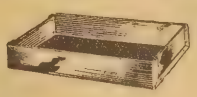

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6 x 4 x 2	7/-
8 x 5 x 2½	9/3
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13 x 10 x 2½	15/-
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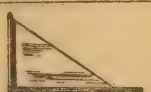
METAL CASES

All steel, 20G, wrinkled finish, solidly constructed.

5 x 5 x 4	17/3
7 x 6 x 4½	18/9
9 x 7 x 5½	20/6



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All steel, 20G, black wrinkled finish.

6" Louvred	16/3
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Size	16½	18	19	25
100ft	10/-	7/3	6/6	3/6
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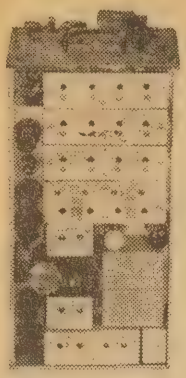

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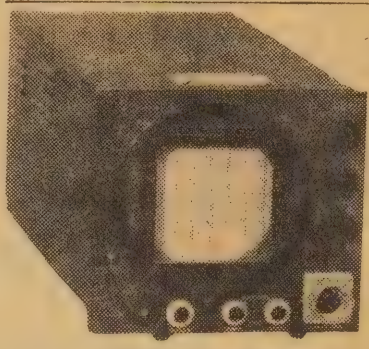
Postage N.S.W. 4/-, Int. 6/6.



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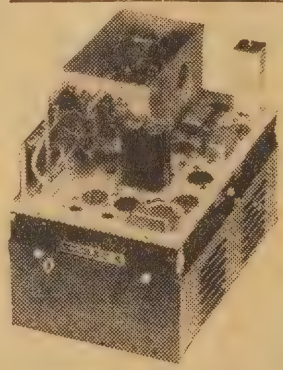

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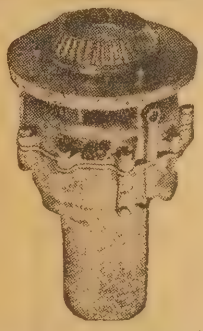

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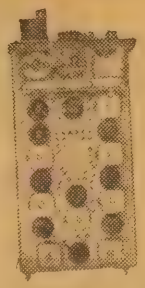
PHONE LM3610

AMERICAN H.F. RECEIVER ASB4



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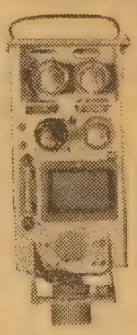

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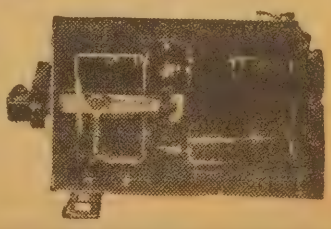

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A COURSE IN TELEVISION

PART 46 — AMATEUR STATION INTERFERENCE

Because of their wide band-width, television receivers are particularly prone to interference troubles from other services, notably commercial and amateur transmitters. This survey of suppression methods, as currently employed in America, should prove valuable as a reference to local operators of amateur stations.

THE burden of finding solutions to such problems rests upon the licensee of the transmitter causing the interference, and upon the owner of the set being interfered with—or his service technician.

Usually, a satisfactory solution can only be arrived at through the complete co-operation of all parties concerned.

The American amateur radio operator, because of greater numbers, closer proximity to owners of TV sets, has spear-headed the technical battle to find cures for this threat to his hobby.

HIGHER POWER

Now, with many "hams" again able to operate at full one-kilowatt input in the midst of dozens of TV receivers, the battle has been won. There remains only the job of educating others in the methods employed.

The most powerful tool which has been applied to the elimination of television interference (TVI) is the frequency selective filter. This issue discusses the application of filter networks to television interference elimination and describes the construction of practical filters for use at the source of the interference, as well as at the TV set.

Because of the lack of selectivity inherent in modern television receivers, they are particularly prone to interference by spurious signals of many kinds

HARMONIC OUTPUT

When one considers that the minimum band-pass for tuned receiver "front-ends" is about 6 mc. and that many using untuned grounded-grid RF stages will accept signals over a band many times this width, it is seen why this is so.

For example, an amateur transmitter operating at 7 mc. may radiate a small amount of power at each of the harmonics (multiples) of his frequency.

The amplitudes of these harmonics diminish rapidly with frequency, but multiples up to the 16th or 18th may be of sufficient strength to interfere with a weak television signal, depending upon the proximity of the amateur transmitter and its adjustment.

Thus, with a harmonic falling every 7 mc., the transmitter stands a good chance of interfering with TV channels 2, 3, 4 and 5, since the 8th through 11th harmonics of 7 mc. fall within them

The degree of interference is usually determined by the proximity of the harmonic to the frequency of the picture carrier. If it is close, the harmonic must be weaker by about 50 db. to avoid interference.

By far the most serious harmonic interference is that caused by the second harmonic of "ham" stations operating in the 28 mc. band, since this harmonic falls directly in channel 2 and is usually quite strong

Another such case of troublesome interference is occasioned by the second harmonics of FM stations which fall within the high-band TV channels.

The commercial solution to this problem has been similar to that adopted by amateurs — the use of filters to prevent spurious radiation.

TVI may also be caused by low-frequency signals getting into the receiver IF stages, either through the tuner or by direct pick-up in the set wiring.

Cases have been observed where picture reception was prevented by signals from European shortwave broadcast stations leaking into the 21.25-25.75 mc. IF channel. This type of interference is usually characterised by the fact that all TV channels are affected, regardless of tuning.

Of course, the most effective approach to interference elimination is to start at the source. The harmonic content of the transmitted signal is tremendously affected by circuit adjustments such as grid bias, grid drive, modulation percentage and tank circuit L-C ratio.

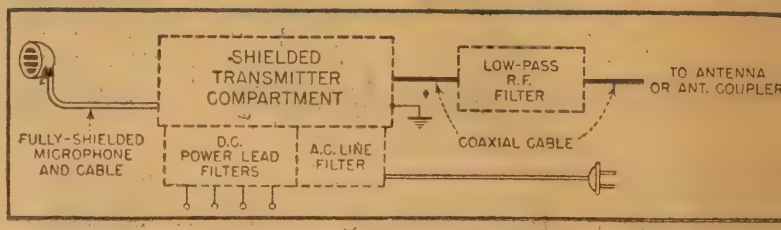


Fig. 1. Illustrating use of complete shielding and filtering at transmitter.

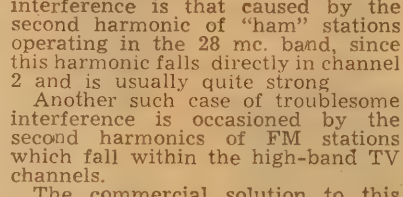


Fig. 2. Low-pass line filter

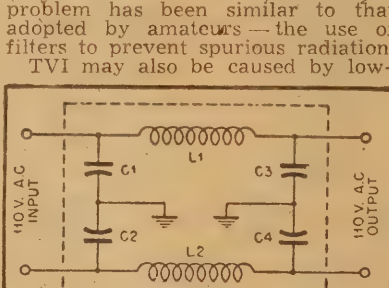


Fig. 3. Showing method of filtering transmitter DC leads.

PROPER DESIGN

If the generation of harmonics and parasitics is first minimised by the selection of the proper values for these variables, the job of preventing the radiation of the remainder is considerably simplified.

In addition, it has usually proved necessary to completely shield the offending transmitter before the work of harmonic suppression by the use of filters can proceed. Otherwise, harmonic radiation may occur from the final tank coil and other parts of the transmitter.

Since the wavelengths of the harmonics which cause TVI are relatively short, leads of moderate length may act as efficient antennas.

The need for shielding may be determined by loading the transmitter with a "dummy" lamp-load substituted for the antenna. If the TVI clears up, it indicates that the interfering signal is being radiated by the antennae and that the present degree of shielding is adequate

If this test shows that more shielding is needed, the type required need not be elaborate, but must be complete.

Commercially built metal cabinets although neat in appearance, do not always provide effective shielding

cause of poorly-bonded joints, ors, cracks, and ventilating louvres. The most popular method of ielding employed in amateur prac- e is to enclose the entire trans- itter RF chassis in a box made up close-mesh copper screening, sol- red at all junctions to make it solutely RF-proof. This shielded assis and panel may then be ounted in a standard rack or cabi- et to improve the appearance.

With the RF portions of the trans- itter thus completely shielded, it comes a relatively simple matter filter all leads entering this metal closure, in the manner indicated Fig. 1.

It must be remembered that the ey or microphone lead is a poten- al source of RF leakage and must e either shielded or filtered. Any C power leads which enter the hassis must also be filtered. For his purpose, a balanced single pi- ection, low-pass filter as shown in ig. 2 may be employed.

METAL BOX

A unit of this type may be con- tructed in a small metal box and onded solidly to the outside of ransmitter shield box for maximum ffectiveness.

The line filter should not be as- embled inside of the transmitter ousing because of the danger of he components coupling to har- onics from the tank circuit.

For DC leads which enter the hielded compartment, a single -section low-pass filter of the type llustrated in Fig. 3 has proved ef- ective in preventing RF leakage.

The values of the components are ot critical, but they should be of igh quality. Inductances should be f a universal-wound type so that istributed capacitance is reduced. Mica capacitors should be chosen, ccording to voltage requirements. A lter of this kind should be used in ach DC lead which might conduct RF out of the shielded housing.

Like the line filter, these DC fil- ers should also be assembled in a eparate metal box, which is fast- ned to the outside of the main hield compartment. A common ousing may be used for all power ead filters.

After the job of shielding the ransmitter and filtering all power eads has been completed, it should e checked again for TVI. If all igns of interference to nearby tele- ision receivers have disappeared vhen full transmitter power is ap- lied to a dummy load inside of he shielded compartment under onditions of full modulation or key- ng, this part of the job is satisfac- ory.

POSSIBLE OVERLOAD

If the interference appears when he antenna is again connected, the TVI is reaching the receiver by adiation from the antenna. It may e of the harmonic type or the eceiver overloading type.

At this point it is well to deter- nine which, since further changes at he transmitter will not eliminate he latter type. The harmonic con- ent of the transmitter signal may e checked by listening on the mul- iples of the operating frequency vith a good VHF receiver, or by uilding a crystal "harmonic hecker."

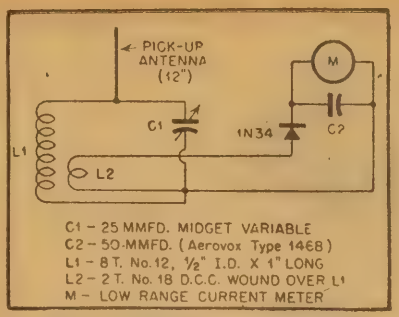


Fig. 4. Crystal harmonic checker.

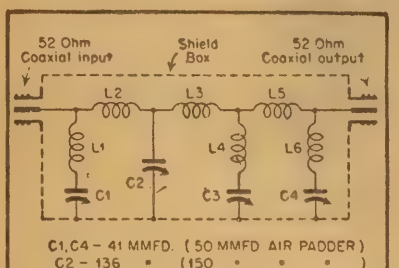

52 Ohm Coaxial input
Shield Box
52 Ohm Coaxial output
L1
L2
L3
L4
L5
L6
C1
C2
C3
C4
C1,C4 – 41 MMFD. (50 MMFD AIR PADDER)
C2 – 136 " (150 " " ")
C3 – 106 " (150 " " ")
L1,L6 – 4 T. No.12 E. ½" I.D. X ½" LONG
L2 – 5 T. No.12 E. ½" I.D. X 3/8" LONG
L3 – 6 T. No.12 E. ½" I.D. X 13/16" LONG
L4 – 4 T. No.14 E. ¼" I.D. X 3/8" LONG
L5 – 5 T. No.12 E. ½" I.D. X ¾" LONG

Fig. 5. Low-pass transmitter filter.

The circuit of a simple device which fulfills this requirement is shown in Fig. 4. It consists of a parallel L-C circuit which tunes to the low TV frequencies, and which is link-coupled to a crystal rectifier and indicating meter. The tuned circuit must be calibrated in frequency so that harmonics may be identified.

Absorption wavemeters may be used for harmonic checking by the addition of the crystal indicating circuit. Alternately, a grid-dip meter of the type which has provisions for operating the oscillator tube as a diode detector may be employed for locating harmonics.

HARMONIC CHECKER

The harmonic checker should be loosely coupled to the output of the transmitter and a systematic search for spurious frequencies made. The sensitivity of the indicator will be better if a low range microammeter is used. The frequency of all signals detected, other than the carrier, should be carefully tabulated, since this information will prove of value in determining filter requirements.

If any radiation is detected in the television bands, a filter between the transmitter and the antenna is necessary. Ideally, this filter should be a unit which transmits the amateur frequencies without loss, while presenting infinite attenuation to all TV band frequencies

Actually, these conditions may be approached with modern low-pass filters of the "m-derived" type. With such network of relatively simple design it is possible to obtain attenuations greater than 100 db. at all television frequencies. If high quality components are used, the "insertion loss" in the amateur bands below 30 mc may be less than .2 db.

In addition, the attenuation at any given frequency within the rejection band may be "peaked up" by special design. In this way, added attenuation may be provided at specific frequencies where harmonic output is greatest.

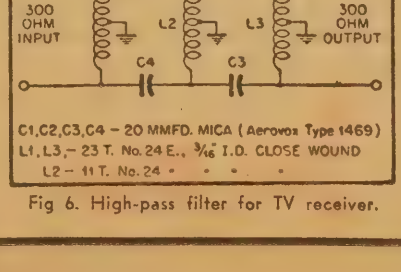


Fig 6. High-pass filter for TV receiver.

LOW-PASS FILTER

A practical low-pass filter for use with amateur transmitters is shown in Fig. 5. This network starts attenuating at 45 mc. and should provide over 65 db. attenuation at all frequencies above 55 mc.

It consists of four sections; two series m-derived end sections; one constant-K type intermediate section with maximum rejection frequency, and one series m-derived intermediate section with maximum attenuation at 71.25 mc.

The filter is designed for use with shielded coaxial transmission line having 52 ohms characteristic impedance. The problems associated with transmitter shielding and output filtering are appreciably simplified if shielded cable is used.

The filter is assembled in a suitable metal shield can having a tight-fitting cover. The transmission line enters the filter box through coaxial cable connectors which are soldered solidly to the metal box for perfect shielding.

The lay-out of the parts is approximately as indicated in the schematic (Fig. 5). The capacitors are small air-padders which have sufficient spacing for the power to be handled. They should be adjusted to the capacitance values indicated in Fig. 5.

All coils are self-supporting and must be kept one diameter away from other metal objects to insure accurate inductance values. The coil lengths specified in Fig. 5 are measured between the ends of the first and last turns. Lead lengths should be limited to about one-half inch.

CHECKING FILTER

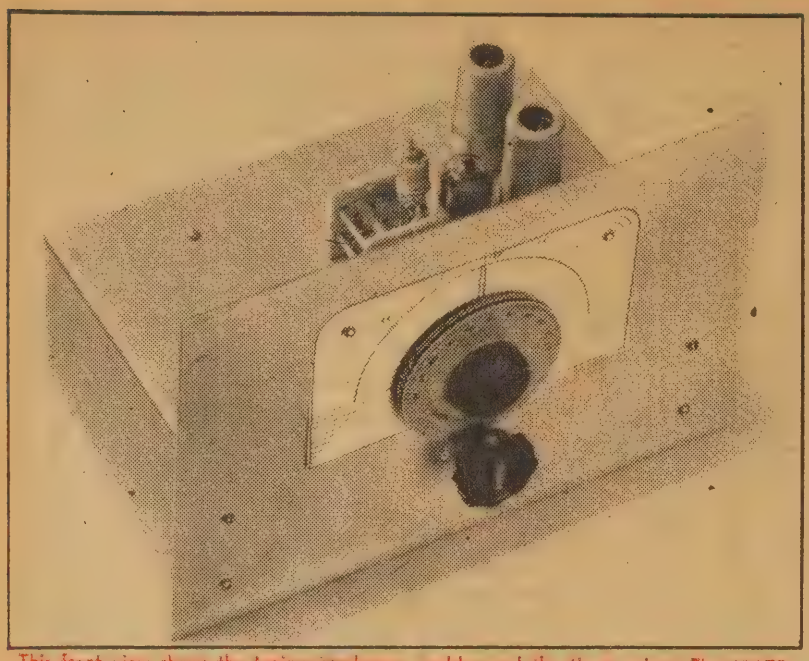
The completed filter should be tested for proper functioning. A rough check may be made by exploring the frequency range near the intended cut-off frequency by means of a signal generator coupled to the input of the filter and an indicating device coupled to the filter output.

If sufficient output is available from the signal source, a 50 ohm terminating resistor may be placed across the filter output and the power in it monitored with the crystal harmonic checker. The power transmitted through the filter should drop very abruptly at 45 mc.

A transmitter of another service may cause television interference even though its signal is in accordance with the best engineering practices.

If it is located in the immediate

(Continued on Page 96)



This front view shows the tuning condenser, padder and the three valves. The 12AT7 is unshielded. The condenser should be reduced to one moving, two fixed plates per section.

144 Mc. CASCODE CONVERTER

The interest in VHF is steadily growing among amateurs. This month's project is a practical example of the changing technique applicable to 144Mc against 50Mc, and in addition represents a carefully tested design which can be relied upon to give first class results. Once again we have taken particular care with our layout illustrations.

by John Moyle

THIS month it is intended to describe a perfectly standard type of converter for reception on the amateur 144 mc band in the hope that it will not only help some to get good results on that band, but possibly encourage others to make a start.

This isn't the only type of converter which is suitable or even good for 144 mc but, besides giving exceptionally good signal-to-noise ratio and plenty of sensitivity, which are much the same thing, it isn't at all critical to get going, despite its three valves.

INITIAL STAGES

Communication on 144 mc has passed well out of the initial stage in which it was useful as a local band only. Before modern circuits were evolved, it was a happy hunting ground for modulated oscillators and super-regenerative receivers as was 50 mc before it.

This equipment just wasn't good enough to do much more than cover local areas, although some of the better examples did occasionally turn in such good results as to indicate that the range of communication could be vastly extended.

As might be expected, wartime development of components and hook-ups, particularly for radar, proved this point beyond doubt, and now it is so comparatively easy to make a start with good gear that it is scarcely worth while even for the new-comer to pass through the "rush-box" stage. In fact it's a good thing to avoid it, for the cruder equipment is likely to demand so much band space as to seriously hamper the majority of amateurs, who have adopted crystal-controlled transmitters and selective receivers.

Naturally our own experience is mostly confined to operating from Sydney, and it may come as a shock to many to know that more than one Sydney amateur is able to obtain good communication on both CW and phone with places up to 200 miles away. Newcastle to Sydney is no longer regarded as a long haul, given reasonable location and good aerials. More and more country stations are popping up all the time, and much the same story is being told on this and similar bands all over Australia.

Because of this great expansion range, and the unrivalled opportu ities presented for further expe ment, we feel that a converter of t type shown here is well worth co sidering as a first effort.

A glance at the possibly unfamil circuit and construction may le you to imagine that you could nev get it going after it had been bu Strangely enough, although the c code is capable of just about t best all-round sensitivity and no factor of the circuits in general u it is not at all hard to line up or use.

It is quite true that for the ve best performance some experien and perhaps extra test equipment required but, once the oscillator h been guided to its right frequen very nearly maximum performan can be obtained by using comm sense and the human ear. Even w the signal frequency coils appreciab out of alignment, little drop in t average local station signals will experienced.

CONVENTIONAL CIRCUIT

In order to demonstrate this poi our converter was built up using deliberately conventional version the cascode principle, and lined by the simple procedure of sprin ing coil turns in and out and noti changes in received signal strength

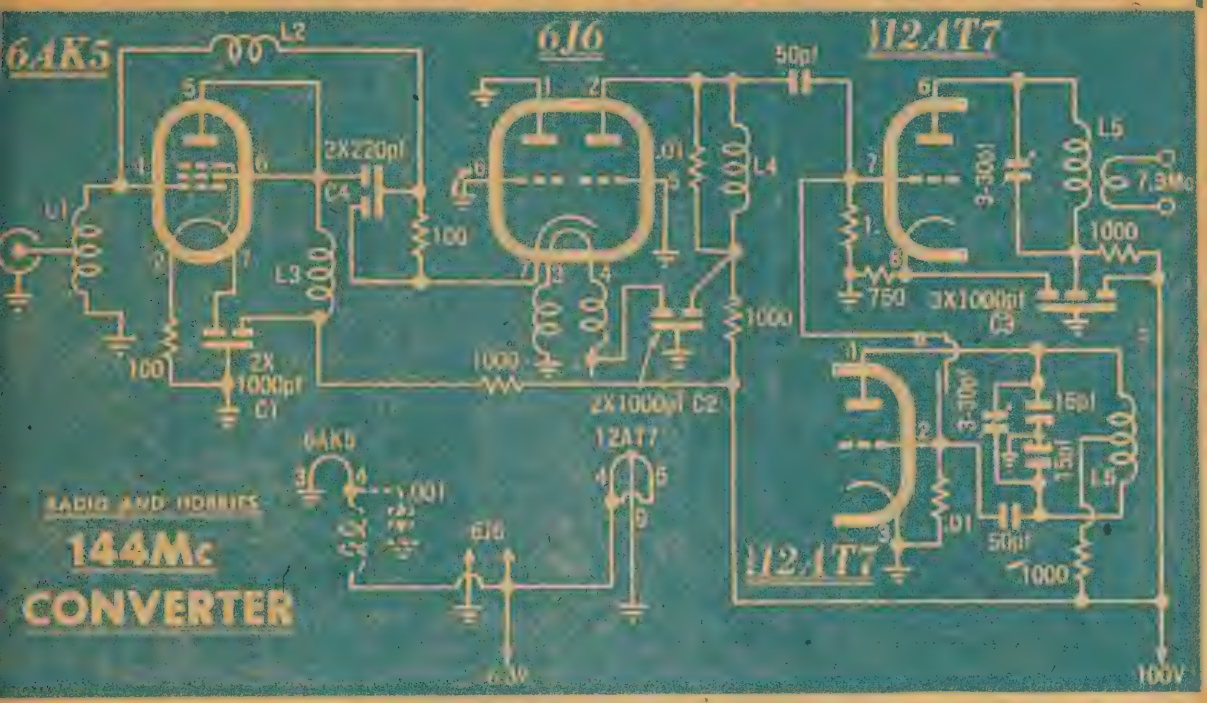
It was then compared with second converter using virtually t same circuit, but which had be most carefully adjusted with a VH noise generator, and by actual a experience over a period betwe the stations of VK2ANF in Sydne and VK2WH in Forbes. The sam aerial was used, and a quick chang over made during reception. T "hotted-up" converter had a slig edge over our own, but VK2W could be received at very nearly t same strength and intelligibility both. A test on the noise generat showed that our converter indicat a noise figure of about 6.5 db again the 4.5 db of the other.

NEUTRALIZING

Subsequent attention to the neu ralising coil, which we had install without any adjustment at all, in proved the noise figure by approx mately the missing 2 db on our ov generator, so that the two jobs this regard are now about level pe ging. It is generally accepted th 4.5 db is about the best noise figu we can expect from this circuit.

Although we are cautious abo quoting noise figures on an absolu basis, we think these should be fair

CIRCUIT DIAGRAM OF THE 144 Mc CONVERTER



The multiple bypass condensers have been grouped for easy identification. Ordinary mica types should not be used. All circuit features follow well-established practice. The RF choke in the 6AK5 filament circuit is sometimes used but not essential.

presentative and certainly quite eful as comparative measurements. This test bore out the belief that e cascode circuit is quite within e ability of the average man to ild and to adjust for really good ception without any special aids. The reason for this is that the sig- l circuits are not sharply tuned t have a fairly even response over veral megacycles of band width. his technique, which is quite com- on these days, is made possible by e use of valves which have a very gh mutual conductance. More am- ification could be obtained by using em in circuits which would give aximum gain but, when listening r weak signals, gain is quite use- ss unless the noise contributed by e valves themselves is low in pro- rtion.

OISE FACTOR

In other words, sensitivity must be oted not in terms of mere ampli- ation, but as the ratio between the ise generated in the converter and e signal itself. If we achieve ough sensitivity to hear the signals, d then manage to reduce converter ise without losing any of the sen- ivity, the useful gain we achieve in effect increased.

That is why in adjusting the con- rter for the ultimate performance, e concentrate on reducing the noise, her by ear or by using a noise nerator, knowing that our circuitry s already provided all the actual plification we require.

In the cascode, this procedure is duced to a mere mechanical pro- ss of altering the inductance of the ls by changing the spacing be- een turns, assuming that these ve first been specified as suitable cover the band in which we are erested.

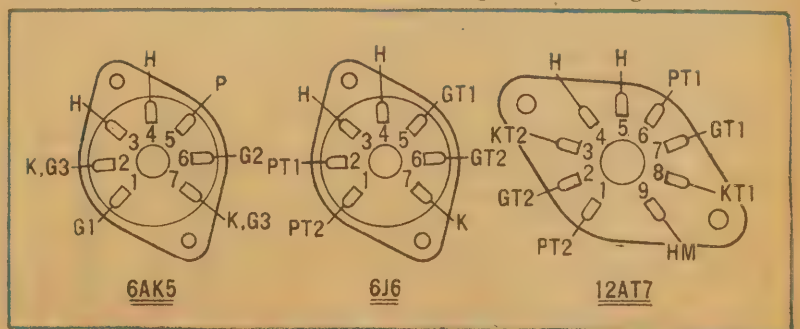
To assist accurate duplication of the original, we have prepared a special layout diagram showing the exact position of valve sockets, coils, and important bypasses &c., leaving out non-critical wires and components for the sake of clarity. It is not suggested that this is the only lay- out which will be successful, but at least it can be considered as capable of producing really good results and easy to duplicate.

The cascode consists of the first two valves in the converter, to which may be added various mixer-oscil- lator combinations. Sometimes the oscillator is crystal controlled, and the tuning done by the receiver into which it feeds. This is possible be- cause of the wide band-width of the tuning end. Thus we got the crystal- controlled converter widely in use. The cascode circuit itself, however, is just the same whether we tune the oscillator or use a crystal, the only difference being in the order of os- cillator stability. This point is worth remembering because it is often con- sidered that the cascode and crystal control are somehow inseparable.

Considering the operation of the cascode, we'll start with the 6J6. Only one half of this valve is used, and its unusual hookup is a grounded grid RF amplifier, with the signal fed into the cathode circuit. Without pursuing the theory of the grounded grid amplifier, it is a particularly low noise circuit widely used on VHF, quite stable because the grounded grid acts as a shield be- tween the cathode and the plate. The 6J6 has a very high Gm which, with its low noise contribution, provided a good deal of useable amplification. Several other high Gm valves could be used, but the 6J6 is one of the best.

AERIAL COUPLING

Unfortunately the impedance of the cathode circuit of such a hookup is extremely low, and it woudl not be possible to efficiently couple the aerial to it. Therefore a second am- plifier stage is connected ahead of it using a conventional triode amplifier circuit wtih a standard tuning coil arrangement in the grid circuit.



This diagram shows the various valve socket connections from beneath.

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RF106 L.T. Vib. Choke.
RF15 ¾ amp Line Filter Coils (2).

If the component you require is not readily available at your local stockists, please contact R.C.S. Pty. Ltd., and they will arrange for it to be supplied to you on their urgent 24 hours service basis.

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651 FOREST ROAD, BEXLEY—LW3491

t isn't much easier to obtain effi-
nt coupling between the cathode
cuit of the 6J6 and the plate cir-
t of the new valve, and most of
gain from the 6AK5 is lost at
s point. But we have obtained
v a normal aerial coupling circuit
viously denied to us, and the over-
improvement is very much worth-
ile.

he 6AK5 connected as a triode is
d because it has extremely good
racteristics in such service and a
y low noise figure. But, being a
de, it will be regenerative as its
d and plate circuits are tuned to
same frequency. This regenera-
n may not cause oscillation because
grid circuit is purposely heavily
ded by the aerial and the plate
cuit even more heavily loaded by
low impedance of the 6J6 cathode
cuit.

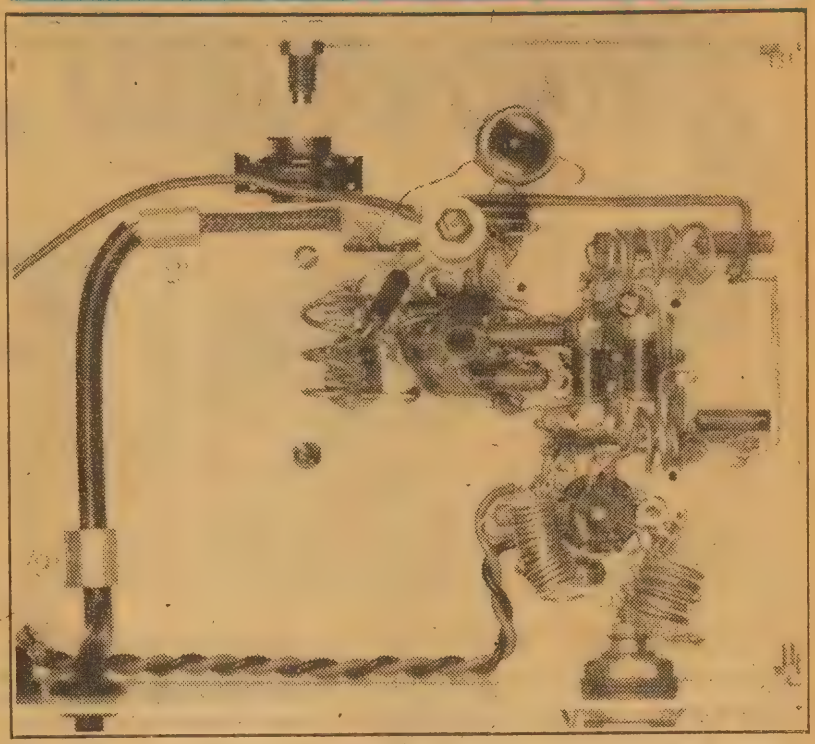
GENERATION

But regeneration is a bad builder-
of valve noise, and neutralisation
herefore applied, of the inductive
e, by connecting a suitable coil
m grid to plate circuit. Sometimes
s coil is omitted but it is essential
he lowest possible noise figure is
be obtained.

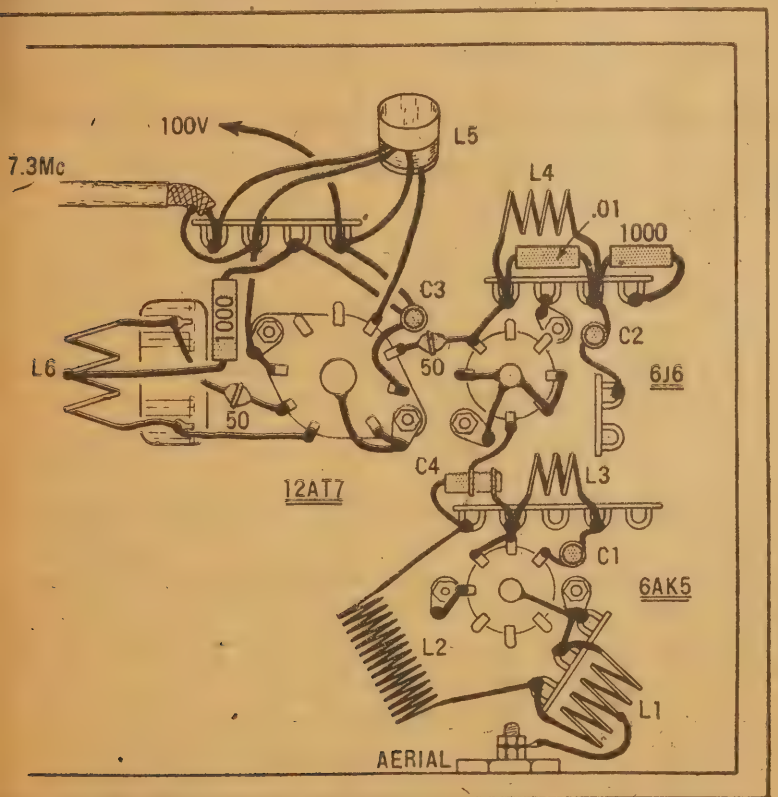
The coil which tunes most sharply
n the plate circuit of the 6J6, for
s least heavily loaded. To ensure
equate broad-banding, a resistor is
ed across it which may not be
essary if the full band isn't re-
red. The gain is slightly higher
hout the resistor, but performance
erwise much the same.

The 100 ohm resistor and 220 pf
ndensers in the 6J6 cathode circuit

UNDER-CHASSIS OF CONVERTER



This picture shows components omitted from the diagram below, such as the 6J6 filament choke and various resistors. The power socket is just visible at lower left. The output lead is 70 ohm co-axial cable.



This diagram positions all critical components. The multiple condensers have threaded ends which bolt to the chassis for earth connections except for C4. Leads to L2 have been extended for clarity and those to C3 can be made shorter by mounting the tag strip nearer to the 12AT7. Otherwise the drawing is to scale.

are normal bias components with an earth return through L1. The 220 pf coupling condenser isn't critical in value and blocks the plate voltage of the 6AK5.

The RF chokes in the filament circuit are necessary in the case of the 6J6 but not so much for the 6AK5, the heater-cathode capacitance of the 6J6 otherwise being directly across L4. Apart from decoupling the various plate leads that's all there is to the cascode.

It is followed by a standard mixer-oscillator circuit using the twin-triode 12AT7. The mixer plate includes a coupling coil tuned to 7.3 Mc in our case for feeding into a standard receiver.

The oscillator is extremely simple, its main requirement being the greatest possible mechanical stability. For this reason the tuning condenser, actually an IFF type widely used, is mounted above the chassis and the coil of heavy wire connected to its stators so that it projects beneath the chassis through a rectangular hole.

PADDING CONDENSER

The padding condenser is wired across the "gang" and may be of any type giving a few pf for band adjustment. Ours was a 3-30, but the 1½-7 type would be less critical to adjust and maybe less prone to shift. A small pre-set miniature condenser might be even better and possibly more stable. It could also be connected across the coil under the chassis.

This type of construction keeps the coil well away from any valve heat-

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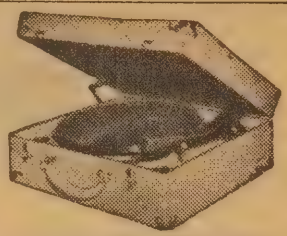

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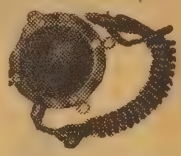

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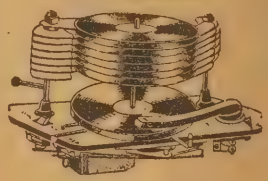

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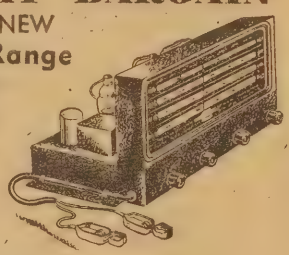

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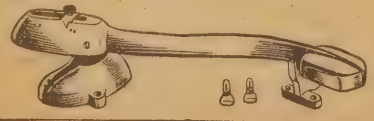

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g, a frequent cause of oscillator ift. The need for rigid construction n't be too strongly stressed. The opping resistor connected to the ntre tap is supported at the far d to a tag strip, giving further acing to the coil against vibration. ere should be little chance of assis movement at this point.

The tuning coils are firmly mount- also on tag strips and are mounted give the shortest possible leads to e valve sockets. Short leads are ite essential. In fact, the whole yout rests on oscillator coil place- ent, orientation of valve sockets, acement of other coils to give short ads, and the use of "stick" bypass ndensers for the same reason. These atters arranged, as per our special agram, the various resistors and okes are not critical and may be laced for the simplest and most cessible layout. Most of these can e traced in our photograph.

Incidentally the filament chokes ere taken from an IFF set and work ite well. They have about 25 turns n ¼-inch former using 30-gauge ire, cemented in place with coil ope. They could be self-supporting, sing wire a little heavier with the ame specifications.

It isn't strictly necessary to by- ass both cathode terminals of the AK5 as the stage gain isn't very igh. The resistor can connect to ne and the bypass to the other.

UNING CONDENSER

Make sure the tuning condenser is n good order with no appreciable earing lash. Some of this type aren't he best in this regard, and there are etter ball-bearing types available. Iowever, there's no need to spend oney this way until you are sure ours won't do. Ours was an average ample and isn't too bad, even using highly selective 7.3 Mc receiver.

The dial, too, should be smooth and ell mounted. There are endless ariations on this theme and ours ame from the disposals counter.

The aerial connection is quite im- ortant for best noise figure. Con- derable research reveals that a coil f the dimensions given, and with the 0 ohm input connected as indicated, rovides slight over-coupling and owest noise, a result confirmed by alculation. This noise business is uite a subject on its own and there s wisdom in accepting the guidance f those who have been through the ill under laboratory conditions.

CIRCUIT VARIATIONS

There are a number of variations o the cascode principle, many of hich are good and some simpler an this standard circuit. Our only omment here is that it's a good plan o gain experience with something hich is beyond doubt for reliability nd results before branching out into ther versions.

Overseas a special valve has been eveloped combining the functions of he 6AK5 and the 6J6. It is possible o get good results by using a 12AT7 o replace these two, although the ielding between the two sections n't the best. Our selection of the onventional circuit isn't meant to mply that it's the only way.

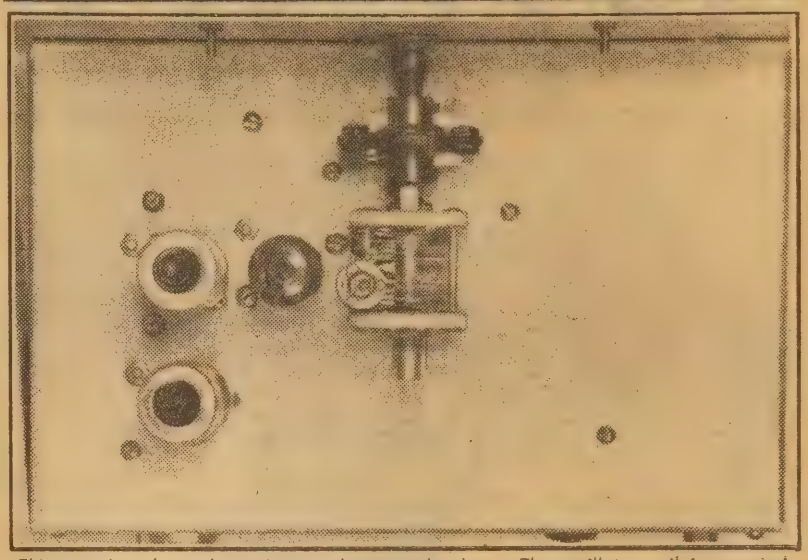
Having built the converter, the first ing is to get the oscillator aligned o 144 less 7.3 Mc, or 136.7 Mc, with he gang nearly all in. The simplest ay is to call on a friend who has a grid-dip meter covering this band, or to play around with the adjustment when you know a strong local station is operating. Many frequency meters will produce enough output for you to identify a harmonic even at this high frequency, and you can take it from there. I doubt whether any builder will not be able to organise some assistance for this all-important job.

Our oscillator coil spread the band just nicely on the dial. At first it was insufficient, but we remedied this by opening out the turns. You will have to do some listening, or enlist the invaluable grid-dip meter to help you here.

The meter can also be used to adjust the other coils to the 144 Mc band, but this job can be done reasonably well by varying their spacing with aerial connected until you can peak them on noise level. Any device such as an electric razor can be used as a generator of noise to help peak them. You can double-check by listening to steady but weak signals, particularly if the receiver used with the converter has a signal strength meter to register improvements as they are made. Although we refer to a "peak" it isn't really sharp enough to justify the word, except for L4.

The neutralising coil is adjusted by a technique similar to that used in the old days of the neutrodyne. Disconnect the filament lead from the terminal of the 6AK5 not connected to the chassis so that the filament does not light. Tune to a fairly strong local station which will be heard at greatly reduced strength. Now spring the neutralising coil so that the turns are spaced in such a manner that the station either disappears or is reduced to its minimum level. If it was originally very strong, there is probably enough direct pickup on the coils to leave

TOP CHASSIS VIEW OF CONVERTER



This top view shows the tuning condenser and valves. The oscillator coil is mounted to the under side of the condenser through a rectangular hole cut in the chassis.

COIL DATA

All coils except L2 and L5 wound with 16 gauge wire ⅜in inside diameter.
L1—5 turns ⅝in long tapped 2½ turns.
L2—15 turns 24 gauge 5/16in diameter.
L3—3 turns spaced 1in diameter.
L4—4 turns wide spaced.
L5—44 turns of 28 enamelled wire, close wound on ⅜in former. Output winding, 5 turns over bottom end,
L6—3 turns about ⅞in long.

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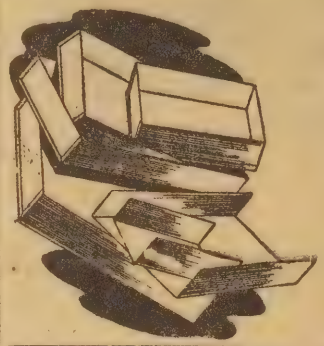

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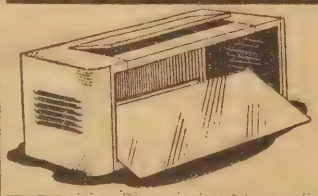

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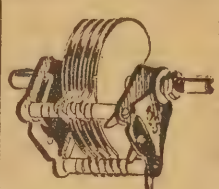

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1000 ohm	Part No.	3C40
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5000 ohm	Part No.	3C46
6000 ohm	Part No.	3C47

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5K	Part No.	3C69
6K	Part No.	3C70
9K	Part No.	3C71
10K	Part No.	3C72
13K	Part No.	3C73
15K	Part No.	3C74
20K	Part No.	3C75
25K	Part No.	3C76
30K	Part No.	3C77

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15 ohm	Part No.	3C49
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75 ohm	Part No.	3C52
125 ohm	Part. No.	3C53
130 ohm	Part No.	3C54
200 ohm	Part No.	3C55
300 ohm	Part No.	3C56
350 ohm	Part No.	3C57
400 ohm	Part No.	3C58
450 ohm	Part No.	3C59
500 ohm	Part No.	3C60
600 ohm	Part No.	3C61
700 ohm	Part No.	3C62
750 ohm	Part No.	3C63
800 ohm	Part No.	3C64

35K	Part No.	3C78
40K	Part No.	3C79
60K	Part No.	3C80
65K	Part No.	3C81
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ne signal, but an average good nal should disappear altogether. nen this happens, the stage is utralised. In our case this was nieved with the coil quite closely aced.

The final adjustment is best made th a special VHF noise generator the type described in our issue of ne and July, 1950, but you'll be ite familiar with the job before orrying about the finer points such this.

We have found this converter par-ularly stable, it being possible to ndle it almost roughly without rious results on reception. Oscilla-r drift isn't noticeable after about minutes warming up, and the terodyne note on 144 Mc carriers ows up as T8-9.

A few final points are worth men-ning. The multiple bypass "stick" ndensers can be had either with wire lead for earth connection with a threaded end which allows em to be bolted to the chassis for rthing in a vertical position. We opted this course because it is mpler and saves space. In the ustrations, these condensers there-re appear as small "end-on" circles th wires coming away from them. e exception is C4 which is best ndled with all pig-tail connec-ns.

Although there is enough mixing tween the mixer and the oscil-or through internal valve coup-g, it is usual to add a little more means of a few extra pf between ds. To get this very small capa-ance, a section of 72 ohm twin-d is often used, about ½in long, litting out the wires at this point make pig-tail connections. Two ces of thin hook-up wire twisted couple of times would do. We ven't found this a critical point.

ATHODE BIAS

Many circuits omit the cathode s resistor from the mixer circuit, ying on a 1 meg or .5 meg grid k for adequate bias. We like use a small bias on this valve, wever, and the makers recommend resistor about the value shown.

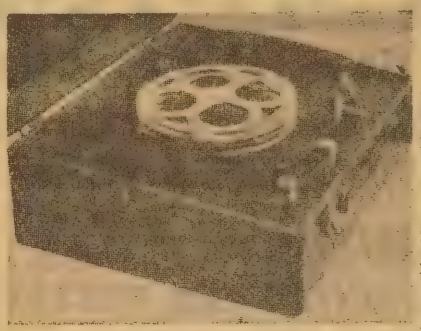
This converter is meant to feed o any short-wave set having a od sensitivity and average selec-ity on 7.3 Mc. Virtually, every ateur receiver comes under this egory, but it should be one which es not use regeneration in the RF tion, or exhibit any instability on Mc. The actual frequency isn't tical, and could be anything up 10 Mc. with perhaps some modi-ation to the converter oscillator l to make it hit the new tuning nge required.

Do not use more than about 120 ts on the converter — the extra ts will not improve results. A arate little power supply is a good ng, and it could be mounted on same chassis. You can tap from ur main receiver, but there are ite a few extra mills involved.

Incidentally, we have carried out ne further work with the 50 Mc verter described last month and very pleased with it. On the se generator, it shows a figure about 4 db which is exception-y good. We have been most im-essed with the new 6AM6 high-Gm ve as a mixer. It needs a modi-d socket connection but looks newhat better than the 6AG5. It ms well worth attention.

Convert Your Gramophone to a real

TAPE RECORDER



FOR

£12/10/-

COMPLETE

THE GRAMO TAPE KIT COMPRISES.
1 Reel EMI tape 1200ft.
1 Take up reel.
1 Clutch System.
1 Record/play back head kit (high impedance.)
1 Erase block (or supersonic 12/6 extra).
2 Corner brackets.
1 Guide roller.
1 3 2 1 Record switch.
1 O.M.E. oscillator coil (High and low impedance).
All resistors and condensers inc. valve socket to make the pre amp.
FULL VERY EASY INSTRUCTIONS.

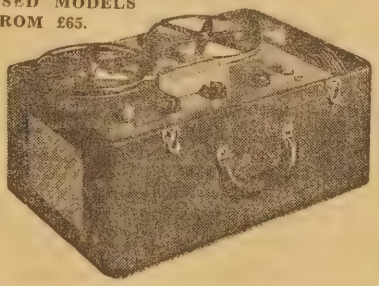
This famous little recorder is now firmly established on the Australian market. Users are most enthusiastic in their praise of this inexpensive way of recording which has been successful in England for the past two years. Results on music and speech are attained with a wide frequency range and are comparable to recorders selling at many, many times the complete price of this conversion kit set which is only £12/10/- inc. tape.
All you need is a little radio knowledge to follow a very simple one valve circuit for the oscillator-cum-two stage pre amplifier, and there it is all ready to record from your radio or amplifier. The turntable is used as the flywheel. THERE ARE NO PARTS TO MAKE ALL that required is a soldering iron, plyers, and screwdriver.
Come in for a demonstration of this new inexpensive way of recording.

Magnetic Tape Recording Heads

High Impedance, Record-Playback head kit, wide frequency range, very simple to assemble. Kit contains, Wound coil on bobbin, MU METAL strip, stalloy packing, solder, chrome case, single hole mounting. £1/12/-. inc. tax. Frequency range obtainable 50/7000c/s.
LOW IMPEDANCE. Record/Playback head kit. Contains MU METAL strip, coil wire, solder, chrome head case single hole mount. 17/6 inc. tax. Very simple instructions.
ERASE HEAD. Low impedance. Contains coil wire, solder, chrome head case.
O.M.E. Supersonic Oscillator, coils, 40kc adjustable slug. A truly first-class coil in shield can. Complete with circuit, 18/6.
MU METAL STRIP heat treated. 3/-, 6/- per strip.

Magnetic Sound Industries (Aust.) Stock

USED MODELS FROM £65.



COMPLETE RECORDERS

As Australia's recording specialist they recommend ONLY THE FOLLOWING for guaranteed and first class performance. These machines are made by reputable firms and require the minimum of service.
MAGICTAPE. New £135/8/4. USED from £85.
ELCON. New £125/-/-. USED from £90.
SOUND MIRROR. New £158/10/-. Used from £95.
EDISWAN. New 129/10/-. USED from £70.
TECHNICORDER. New £129/10/-.
MAGNOFILM New £36/10/-.
See the latest addition to our extensive range of tape recorders THE MAGNOFILM, a high fidelity unit to fit on your turntable. Two speed, frequency range 50/7000 c/s. complete with Scotch Boy tape £36/10/-.
CONVERTOR UNIT. For any tape deck, two valve supersonic oscillator pre amplifier, mic input, record/playback and erase. 6Au6 and 6AQ5 valves, £12/10/-.

RECORDING ACCESSORIES DEPARTMENT

This new department of M.S.I. is now fully stocked with your hard to get requirements.

Record/playback heads 25-8500 cps
super dial track, double gap. £5/9/9.
Erase £5/9/9
Oscillator coils (inc. circuit) 18/6
MU METAL strip 3/-, 5/4, 6/6
Empty reels, all types 6/6, 8/6 10/6
MOTORS £3/10/-
Guide rollers 8/6
Chrome reel adaptors, screw top 12/6.
Microphones from £1/19/9.
Bearings from 9d each.
Head winding wire 2/- per reel.
Magnetic E.M.I. tape, Scotch Boy S Mirror Minor, Pyrol, etc., from £1/14/-.
Why not open a monthly account with MAGNETIC SOUND INDUSTRIES?

WANTED

Used tape recorders in good order well known brands preferably

EASY TERMS ON ANY ARTICLES. MAIL ORDER WITH CONFIDENCE
From our new Country Order Department. Please add postage.

MAGNETIC SOUND INDUSTRIES (AUST.)

1st Floor Crystal Palace Arcade (opp. Regent Theatre)
590 GEORGE STREET, SYDNEY. M3393.
OPEN SATURDAY MORNINGS

A.C.E. RADIO

PHONE: LA 3845

136 VICTORIA RD. MARRICKVILLE, SYDNEY, N.S.W

EVENINGS & WEEKENDS: "KALUA," COLLAROY ST., COLLAROY — XW5956

THE 3 UNITS NEW AIRTESTED £57-10-0

A.R.8 Receiver. 11 Valve 140 KC to 20 Meg **£32/10/-**

A.T.5. Transmitter. Complete with A.C.U. and 1 crystal 140 KC to 500 KC and 2 Meg to 20 Meg V.F.O. 2—20 Meg Crystal. **£27/10/**

THE 3 UNITS AIR TESTED £57-10-0

Also available converted for 240 V A.C. or other required voltages. Prices on application.

New Telephone Line Units

Each contains 1 mil relay 50V selenium rectifier bezel jack, etc. **7/6** Weight 2lb.

1143 & 522 Cables and Plugs

£1/10/- set

A.R.8 8 pin plugs & cable **12/6**

New Multi Core Cable

Metal shielded or T.R. covered 4 to 7 conductor.

1/- per yard.

Minimum 10 yds.

£2/17/6 100yd Coil

AR8 RECEIVERS

Complete with valves. Excellent condition.

£18/10/-

Converted to 240 V. A.C. Complete. with speaker. Airtested.

£28/17/6

AT5 TRANSMITTERS

Complete with valves excellent condition

£9/17/6

AT5 Aerial Coupler Units. New.

£3/17/6

Used. Excellent condition **£2/2/-**

SELENIUM H. DUTY RECTIFIERS

32V 5 AMP

£3/17/6

Selsyn Type Motors

Can be converted to 500 volt A.C. Condenser Start Motors.

Price each **£1/-/-**

Per pair **£1/15/-**

Ideally suited for Tape Recorder with suitable resistor or transformer.

VARIACS

240V 50 Cyc. 8 AMP

£10/17/6

New Bendix Radio Compass Receivers

MN26 A. 150 to 1500 KC

Fully converted for 240 V A.C. operation including speaker.

£29/17/6

CRYSTALS

1000 K.C.

English precision instrument crystals for that frequency meter or V.F.O. check.

£1/7/6

Postage 1/-

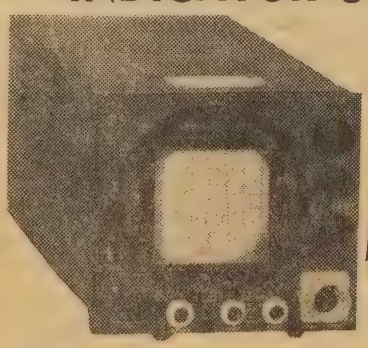
Tele Radio Transmitters

Airtested complete with 1 crystal to required frequency.

£27/10/-

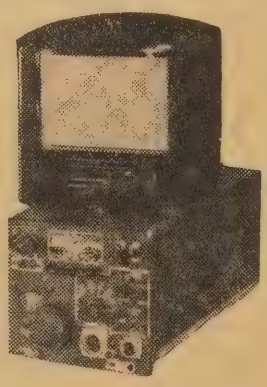
A few 3BZ complete stations, air tested to required voltage and frequency. Prices on application.

INDICATOR UNITS



NEW AMERICAN AND AUSTRALIAN TYPES

For that Oscilloscope. Complete with Valves, 5BP1 CRO tube. **£9/17/6**



A.R.B. AMERICAN COMMUNICATION RECEIVERS

195KC to 9.025MEG Complete with Valves. **£19/10/-**

Converted, Air-tested. Complete with Power Supply and Speaker. 240V AC £29/17/6

24V DC **£27/17/6** 32V DC **£28/17/6**

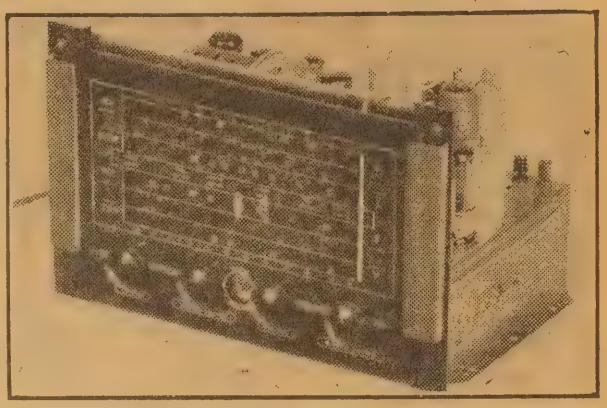
12V DC **£32/17/6** 6V DC **£37/10/-**

Circuit Supplied with each Unit.

TRADE REVIEWS AND RELEASES

LASSIC 10-VALVE RECEIVER

)ne of the latest chassis to be released by Classic Radio is a 10 valve receiver designed to provide number of features and facilities not found on the ormal console receiver and to give a high order f performance under adverse reception conditions.



E circuit employs an RF stage and is designed for both broad- and short-wave reception. These features make it ideally suited use in country areas, where high sitivity is often required to re- e weak signals, while the short- e channels are often the only reasonably free from static. he short-wave section covers the megacycle band in which are ted several Australian short- e channels.

tuning indicator is fitted and es the form of a twin pattern gic-eye valve, the two patterns having different sensitivities, which provided adequate indication on both weak and strong signals.

The audio system employs push-pull 6V6's and is designed for operation from a pick-up as well as the tuner. To facilitate the fitting of a turntable there is a three-pin power outlet on the chassis, while a standard six-pin socket makes available filament and HT voltages for use with an FM tuner or auxiliary audio equipment.

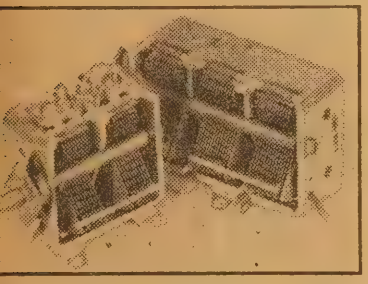
Other features include twin speakers, one eight-inch and one 12-inch, a power switch incorporated in the tone control so that the set may be turned on and off from the front panel, a large edge-lit dial, and illuminated indicators to show which band is in operation.

On test in our laboratory the receiver gave an excellent performance, and, although we did not conduct measured tests on sensitivity and selectivity, it was obvious that the RF stage provided considerably improved performance in both respects, making the set ideal for use in difficult locations.

Mechanically the set appears to be very well made, the dial and other controls operating smoothly, while the dial itself is rigidly mounted on a heavy gauge metal panel. The general layout of the minor components and wiring is very neatly and logically laid out, thus simplifying maintenance problems. Price details are given in current advertisements.

PHILIPS NEW MINIATURE GANGS

Philips Electrical Industries of Australia Pty. Ltd., announce two new miniature gangs, having two and three sections each and being classified as types 4252 and 4253 respectively. The specifications for each section are the same in both cases.



IE maximum capacity is 449 pf and the minimum capacity 10 pf, ng a capacity range of 439 pf. maximum difference between ions is adjusted to within 1 pc en connected into a circuit hav- the normal stray capacities due wiring, trimmers, &c., while the ximum deviation from the pub- ed law is also kept within the c limit.

he insulation between plates is ed at 300 volts, and the recom- nded peak working voltage is 75. ulation resistance is given as bet- than 5000 megohms at 75 pc nidity with higher values to be ected at lower humidities.

he overall height of the units is en as 46 mm (slightly less than inches). The length of the gang, excluding the shaft and bearing, is 50 mm (two inches) for the three gang 75 mm (three nes).

he two outside plates of each ion are slotted to permit small iations in capacity at various de- es of rotation, thus assisting erially in obtaining optimum cking. The tracking law appears be very similar to the old "H" e and would probably track very ely with an "H" dial, which could used until such time as a glass for this law is available.

Another very useful feature of these gangs is a small rectangular plate fitted to the shaft and intended to facilitate the attachment of dial drum. By soldering the drum directly to the plate the need for bushing and set screws is eliminated, thus making possible a very much cheaper drum. This feature will appeal particularly to manufacturers.

Individual earth lugs are fitted to each section, as well as to the frame proper, while each moving plate is individually soldered to the shaft. The fixed plates are mounted on ceramic insulation, and the unit as a whole is very well finished, giving the general impression of excellent design and workmanship.

A new form of pickup head bearing the well known Chancery brand has just been announced by British Merchandising, agents for this brand in Australia. A standard Chancery cartridge, either 78 or microgroove, is fitted to a head using a three-pin plug which is now standard with English manufacturers. Electrically, the performance should be equal to previous Chancery pickups.

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DIRECT TO YOU! ALL ITEMS AVAILABLE EX STOCK!
IMMEDIATE DELIVERY TO ALL PARTS OF AUSTRALIA!

POWER AND FILAMENT TRANSFORMERS

PT's INCLUDE ELECTRO-STATIC SHIELD—ALL TYPES 50 CPS OPERATION

TYPE No.	PRIMARY VOLS	H.T.V. ASIDE	H.T. mA.	FILAMENTS	PRICE
1682- H	220-230-240	285	60	6.3v-2A; 5v-2A	34/-
1636-3H	200-220-230-240	300	80	2 x 6.3v-2A; 5v-3A	42/9
1332-3H	200-220-230-240	300	120	2 x 6.3v-2A; 5v-3A	53/3
1356-3H	200-220-230-240	400	150	5v-3A; 2.5v-5A; 6.3v-4A	70/-
1380-3H	200-220-230-240	450	200	2 x 6.3v-2A; 5v-3A	102/6
1371-8	200-220-230-240	500-600-750-850-1000	300		150/-
1400-19	200-220-230-240	465-500-425	250	2 x 6.3v-3A; 2 x 2.5v-3A, 5v-3A	110/-
1643-23	200 or 230 or 240	—	—	6.3v TAP 5v-2A (500v insul)	17/6
1525-21	200-230-240	—	—	2.5v-10A (1000v insul)	47/6
1305-22	200-220-230-240	—	—	2.5v-10A (3000v insul)	75/-

FILTER CHOKES

Swinging Chokes Marked •

TYPE No	INDUCTANCE-HYS MAX.	INDUCTANCE-HYS FULL RATE DC	CURRENT mA	APPROX. D.C. RES	MAX. D.C. Working Vol.	PRIC
975-23	20	15	60	320	500	16/6
973-9	30	20	80	370	500	33/6
973-21	30	20	80	370	500	25/9
1012-1A	35	20	120	430	1000	35/3
967-1A	35	20	150	200	1000	46/-
956-1A	30	20	200	160	1000	57/9
1011-1A	30	15	250	160	1000	59/6
983-1A	25	20/5	30/300	90	1000	65/6
936-1A	15	10	300	60	1000	62/6

AUDIO OUTPUT TRANSFORMERS

* Response Includes Correction due to Negative Feedback ** For Use With Rola 12-OX Speaker

TYPE AND MOUNTING	IMPEDANCE—OHMS PRIMARY	IMPEDANCE—OHMS SECONDARY	FREQ. RESPONSE DB+−	FREQ. RESPONSE CPS	RATING WATTS	TYPICAL APPLICATION	PRICE
893-23	5000, 7000	2, 3.7, 8, 12.5	1	*40-15,000	5	SINGLE 6V6G, 6AQ5 ETC. TO VC	28/3
894-23	500	2, 3.7, 8, 12.5	2	50-10,000	5	LINE TO VOICE COIL	26/3
900-22	2500, 5000	2, 3.7, 8, 12.5, 15	1	*40-15,000	15	SINGLE 807, EL34 ETC TO VC	57/6
896-9	8000, 10,000	2, 3.7, 8, 12.5, 15	1	30-15,000	15	PP 6V6G's A OR AB1 TO VC	62/6
897-9	8000, 10,000	100, 125, 166, 250, 500	1	30-15,000	15	PP 6V6G's A OR AB1 TO LINE	62/6
763-9	3000, 5000	2, 3.7, 8, 12.5, 15	1	40-20,000	15	PP 2A3's A OR AB1 TO VC	62/6
809-26	500	2, 3.7, 8, 12.5, 15	1	50-20,000	15	LINE TO VOICE COIL	42/6
870-26	10,000	2 or 8	1	*20-20,000	6**	PP 6V6G's OR 807's AS TRIODES	57/6
871-9	10,000	2 or 8	1	*20-20,000	12	PP 6V6G's OR 807's AS TRIODES	81/-
872-9	10,000	3.7 or 15	1	*20-20,000	12	PP 6V6G's OR 807's AS TRIODES	81/-
891-22	6600	83, 100, 125, 166 250, 500	1	50-12,000	35	PP 807's AB1 TO LINE	82/6
892-22	3200	50, 62, 83, 125, 250, 500	1	50-12,000	55	PP 807's AB2 TO LINE	97/-

INPUT TO GRID TRANSFORMERS

511-10	50-100,000 OHMS	MUMETAL CORE	30-10,000 CPS	65/-
509-10	200-100,000 OHMS	MUMETAL CORE	30-10,000 CPS	65/-
502-10	600-100,000 OHMS	MUMETAL CORE	30-10,000 CPS	65/-
563-6	600-60,000 OHMS	STALLOY CORE	200-5000 CPS	42/6

INTERSTAGE TRANSFORMERS

518-6	20,000 TO 20,000 OHMS	SE OR PP	RADIOMETAL CORE	1:1 RATIO 30-10,000 CPS	69/-
519-6	20,000 TO 80,000 OHMS	SE OR PP	RADIOMETAL CORE	1:2 RATIO 30-10,000 CPS	69/-
620-6	20,000 TO 180,000 OHMS	SINGLE ENDED	RADIOMETAL CORE	1:3 RATIO 30-10,000 CPS	69/-

DRIVER TRANSFORMERS

545-9	SE 4000 TO PP AB2 GRIDS 1.6:1. PRIM. TO ½ SEC. RATIO 50-10,000 CPS 5 WATTS	57/6
588-6	SE OR PP 5000 TO PP 807's CLASS B. 200-5000 CPS 5 WATTS	52/6

LOW LEVEL OUTPUT TO LINE TRANSFORMERS

705-6	PP 30,000-600 OHMS	RADIOMETAL CORE. MAX. LEVEL 250 MW. 30-10,000CPS	69/-
712-6	PP 30,000-200 OHMS	RADIOMETAL CORE MAX. LEVEL 250 MW. 30-10,000CPS	69/-
710-6	SE OR PP 20,000-600 OHMS	RADIOMETAL CORE MAX LEVEL 250 MW 30-10,000CPS	69/-
720-6	SE OR PP 20,000-200 OHMS	RADIOMETAL CORE MAX LEVEL 250 MW. 30-10,000CPS	69/-

MODULATION TRANSFORMERS

Primary : 3,800, 5,000, 6,600, 8,500 10,000 ohms. Secondary : 4,000, 5,000, 6,000, 8,000, 10,000 ohms.
150 mA. D.C. per side on Primary. 150 mA. D.C. Maximum Secondary Current.
Freq. Response: 200-7,000 c.p.s. 75 Watts Rating £9/10/-

★ NOTE: 20% SALES TAX TO BE ADDED TO ABOVE PRICES

★ MOUNTING DETAILS:

H—3H: Horizontal mount with steel louvred cover. Sub-terminal panel.
— 8: Open steel clamps. Terminal strip prim & sec.
—19: Horizontal 6" x 5" cast cover. Sub-terminal panel
26—23: Open steel brackets. Terminal strip
6—10— 9: Diecast case with solder terminal
—21: Open steel clamps. Terminal strip
—22: Open steel clamps. Terminal strip
—1A: Vertical steel louvred covers & lead

In Melbourne? Buy From Our Own Showroom. Country or Interstate? Use Our Fast Mail Order Service
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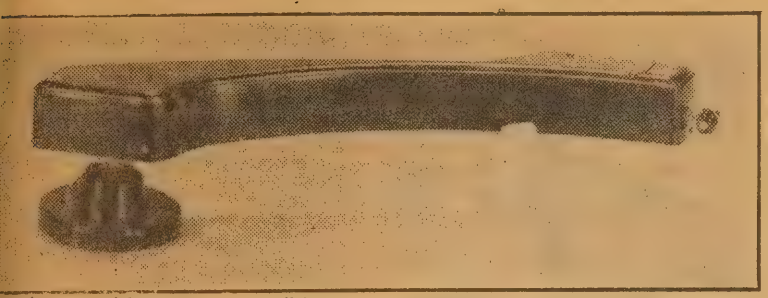
A & R ELECTRONIC EQUIPMENT COMPANY PTY. LTD.

HEAD OFFICE, FACTORY AND SALES: 378 ST. KILDA ROAD, MELBOURNE, VIC.
TELEGRAMS: "ARLEC," MELBOURNE. (OPPOSITE THE SHRINE) TELEPHONE: MX1150.

★ A & R FOR QUALITY ★

NEW ACOS 'TURNOVER' PICK-UP



he latest addition to the well known Acos brand of pickups is the model GP30 incorporating the GP29 cartridge.

IS is a turnover type cartridge having two styli attached to the crystal element, either being ght into playing position by ro- g the entire cartridge. This is ved by means of a small mould- nob on the front of the pickup which is clearly marked to indi- which stylus is in position.

ie makers claim that this pick- s designed to give the best pos- reproduction of both standard long-playing records under con- ns of normal home listening with the average domestic radio In most cases no compensation he input circuit should be re- ed.

with most crystal pickups, the ut is high enough to operate audio portion of most radio sets out the need for additional am- ation. At 1000 cps a standard rd should deliver approximately olt, and about half this from a ogroove.

Each stylus is held in place by means of a small grub screw, thus enabling them to be readily replaced when necessary.

Further information may be obtained from Amplion (Australasia) Pty. Ltd., 36-40 Parramatta Rd., Camperdown, NSW. Price details appear with current advertisements.

PRINTED CIRCUITS

FOLLOWING publication of details in the February issue of the English Technograph Printed Circuits we have been advised that R. H. Cunningham Pty. Ltd., are now agents for Technograph Printed Circuits Ltd., and have available all relevant technical information, which is readily available to readers from their Melbourne office.

Readers requiring further information should write direct to R. H. Cunningham Pty. Ltd., 118 Wattletree Rd., Armadale, SE3, Victoria.

J. H. MAGRATH DEMONSTRATION ROOM

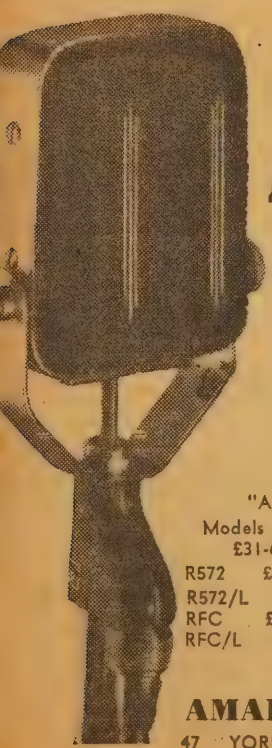
J. H. McGRATH AND CO. PTY. LTD., 208 Little Lonsdale St., Melbourne, announce that they now have a specially equipped room designed to facilitate the demonstration to customers of Steane's amplifier and PA equipment.

A variety of amplifiers, speakers and speaker flares, turntables, pickups, microphones and intercom systems are available for demonstration and each is wired to a central control panel. By this means the demonstrating salesman or engineer can select any combination of units at the touch of a switch, thus enabling the customer to make a direct comparison and avoiding any confusion by reason of loose wires and temporary connections.

The company claims that this is the first time in Australia that such a service has been made available to the general public, and it should certainly be of considerable assistance to a prospective customer, who, lacking technical knowledge, is often confused by the wide variety of units available and is unable to decide which would be best for his particular requirements.

Since the salesman is also assisted by being able to quickly emphasise that a certain combination of equipment is most suitable for his customers' needs, it is likely that this setup will prove equally beneficial to all concerned.

A.W.A. RONETTE CRYSTAL MICROPHONES



Now available in a range of twelve models for
- PUBLIC ADDRESS
- SOUND REINFORCEMENT
- AMATEUR RADIO TRANSMISSION
- PARTY USE WITH YOUR HOME RADIO

ADDITIONAL AND NEW!

The A.W.A. RONETTE models R572/L and RFC/L with inbuilt transformer for use into low impedance long lines.

"B"
0-88 for fixed bracket mount £10-5-6
0-88F with flexible mount cable plug £18-12-0
0-88U for stand mount and cable plug £14-15-6

"A"
Models R474 £31-6-6
R572 £18-19-9
R572/L £22-4-9
RFC £14-19-2
RFC/L £19-0-0

Study the economy of the following prices:

"C"
GS210
£9/3/6

"D"
S742
£16/3/6

"E"
HM7
£7/3/6

"F"
B110
£3/19/7

TECHNICAL PAMPHLETS WILL BE MAILED ON REQUEST

AMALGAMATED WIRELESS (AUSTRALASIA) LIMITED

47 YORK STREET, SYDNEY BO233 — 167 QUEEN STREET, MELBOURNE. MU9161

(2) Are enthusiasts likely to be i terested in adaptors anyway o long term basis?

The point behind this last qu is that adaptors generally ne seem to enjoy long term popula

I remember well the short-w adaptors and converters of the n thirties. They were all the go fo while but how many do you see no Listeners were not happy till t got sets with short-wave coils b in, even though they seldom used facility thereafter.

RECORD PLAYERS

More recently, the same thing h happened with record players a microgroove attachments. They fill the bill for a while but the dema for complete built-in facilities h risen rapidly. As somebody said r cently, "they'd rather pay twice much now for a complete new play than have something at half t price stuck on top."

If you can relate that snippet conversation to the general subje you'll see what I mean.

As for tape, the first big questi is whether it will "take" on a lar scale in the domestic field in t same way that records have take Anybody is entitled to a guess a I've already made mine.

If it does take, you can be qui certain that enthusiasts will sta building or buying complete ampl

Let's Buy An Argument

Though formal acknowledgement has been delayed by the intervention of holidays etc., Mr. Thomas has come to light with a letter which will allow me to round off, for the time being, the discussion of tape recording and allied subjects.

by W. N. Williams

But first I should apologise for the transposition of several lines in the first page of the last article. If you take the eight lines immediately under the heading in column 3 and transpose them to the top of the column, you'll find that the sense is improved no end.

The articles are hard enough to read at any time without turning them into a jumble quiz!

Coming to Mr. Thomas' letter, I must admit to some amusement at his explanation of the goings on at the bus stop.

BEEN WORTH WHILE

In fact, I strongly suspect that he has a sense of humor, which could not be displayed to advantage a few months back, while he and Mr. Thompson were engaged in their verbal fisticuffs.

Sufficient to say, we've had our fun and learned a few things into the bargain.

Mr. Thomas' latest circuit is reproduced for the interest of those who like working out what goes where. Without seeking to comment on individual points, it represents a line of approach which is legitimate if there is no urgency to minimise the total overall number of valves.

The contrast between this and our own tape adaptor is obvious and could lead to some interesting speculation.

(1) Is an audio enthusiast likely to be interested in complex adaptor circuits — 7 valves in this case — if an alternative design is available which meets most of the requirements with only two valves?

fiers that will run from radio, picku or tape at the turn of a single knob.

I can't see any permanent futur in mere adaptors or even in sma complete outfits that ignore the ex pensive speaker and amplifier a ready provided for radio and record It will have to be in the one unit.

However, I rather fancy that am straying from the subject.

Mr. Thomas' objection to my dis cussion about the 6V6 triode is i order. I misread the circuit and, a a result, assumed the plate curren to be much lower than it actuall was. However, the general truth o the contention is not affected an the point remains that there is n clear line of demarcation betwee what has been referred to as "con stant voltage" and "constant current recording.

In fact, the whole sense of th article in the December issue woul appear to support Mr. Thomas rather sweeping statement that "th form of coupling between the hea and amplifier is relatively unim portant, provided it works. The per fect characteristic must still b

eved by the use of correcting
orks . . . &c."
s point about compensation and
hum/signal ratio is well made,
although it cannot be divorced
n matters of convenience and
al/noise ratio elsewhere in the
ge.
hen, too, there is the matter of
flat playback amplifier and the
ible need for compensating each
vidual head before optimum re-
s can be achieved. In some
jects, the situation is familiar.

HAT ABOUT PICKUPS?

n the matter of disc recording,
have progressed to the point
ere it is possible to predict the
ording characteristics fairly ac-
ately and to allow for it in the
ign of the amplifier. The pick-
however, imposes its own special
tern of peaks and troughs on the
l results.
deally, the amplifier should be
ored for each type of pickup—
even each individual pickup—
only the most ardent enthusiasts
r bother doing so. The rest ac-
pt the reproduction as it comes
d manage to ignore most of the
itations.
Tape will inevitably gravitate to
same general position, where
ads will be sufficiently standard-
d or suitably compensated to
ow reasonable interchange of
cordings.
I've played quite a few different
pes recently on a variety of decks
d using an amplifier with bass
ost on playback but level else-
here. For the most part, the re-
oduction has been within limits
hich the average listener would
cept as commonplace.
But every now and again, there
abundant evidence of a particu-
rly poor head or a badly-aligned
p, which leads to an atrocious end
sult.

AP ALIGNMENT

This matter of gap alignment is
mething which simply has to be
rted out. A small error knocks
ff the treble response, a larger one
ads to distortion which is reminis-
ent of recording with insufficient
ias.
Only this week I came across a
iscrepancy between a tape and a
ead which was so great that it re-
uired one side of the head to be
fted off the deck by the thickness
f a spring washer. Then it played
erfectly—but only then.
In another case, two heads, pre-
umably identical, showed similar
esponses at 5.5 and 3.5 Kc, this
ime presumably due to gap width.
We can only hope that such ex-
mples of bad management will
radually become more rare, allow-
ng Tom, Dick and Harry to swap
apes without any great reservation.
To do better than that, we'll prob-
ably have to be just as fussy about
eads, tapes and amplifiers, as we
are at present about records and
pickups.
Finally, Mr. Thomas' assurance
that heads will not be burnt out
by accidental overload from likely
sources is most comforting.
I have heated them up with erase
and bias currents but never to the
point of destruction. The answer to

I didn't miss the bus . . .

In the November issue, you summed up the situation rather neatly in saying that I seem rather uncertain whether I ever wanted to catch the bus which Mr. Thompson announced I had missed. I would go so far as to say that I had no intention of catching it.

Mr. Thompson dragged me to the bus stop and pushed me out on to the road!

Seriously, though, I am not an advocate of constant voltage recording in the ordinary way. It has its advantages, being an easy way to obtain bass boost, and I decided to use it for the purposes of illustration in the article. However, Mr. Thompson maintained that the only possible method of coupling was constant current and, in pointing out the fallacy of this, I have unwittingly made myself appear to be the champion of constant voltage drive.

I am glad that you made a brief mention of the heading to the circuit on page 61 of the September issue. I was not too happy about this myself, as the circuit was drawn with academic rather than economic considerations to the foreground. But I appreciate the reasons for choosing the heading; such a circuit could well be built from junk-box parts.

As a matter of interest, I enclose the circuit of the basic record/playback amplifier I am using at present. This has all the bass boost and some top boost on record and further top boost on playback.

May I add a few words of comment about the "Argument" in the December issue?

The first point concerns the use of a 6V6 as a triode, where you have put the anode impedance at 10,000 ohms. The published value under the conditions given is 2400 ohms. Experiments indicate that the 6V6 as a triode does have a very low impedance and the published figures seem correct.

Hence the choice of a 6V6 in the case under discussion where a 6J5 for instance, would otherwise be suitable.

I think the key to the misunderstanding lies in your phrase "under the very low plate current conditions shown. . . ." The current is actually around 40 mA.

Also you have assumed that the load impedance will be about 250 ohms at 100 cps., whereas I pointed out (page 45, October issue) that the optimum loading of 5000 ohms would occur at a low frequency "which might be 100 cps." (This naturally depends on the head and the transformer but assumes the head impedance to be about 10 ohms at 100 cps.)

It is true that a head having an impedance/frequency curve as on page 41 of the December issue, coupled through an ideal 1:1 transformer to a triode like a 6J5 would behave as you have described but even Mr. Thompson would not call this constant-voltage drive. Certainly it has nothing in common with my circuit in the September issue except the physical hookup.

Mr. Thompson's criticism of constant voltage recording, therefore, still stands as a legitimate argument.

My attitude, on the other hand, was, and is, that the form of coupling between the head and amplifier is relatively unimportant, provided it works. The perfect characteristic must still be achieved by the use of correcting networks and it is the overall response that really matters.

Naturally, it is essential to understand the detailed operation of any circuit and applying the appropriate theory.

You have, I think, made much the same point and, in doing so, have cleared the air considerably.

A statement which calls for comment is that the effect of hum pickup is minimised by avoiding bass boost in the playback channel. Is this true? Whatever characteristic the record channel may have, the maximum recording level at the lowest useable bass frequency will be as close to overload point as it is possible to go, if only to keep it above the hum.

Therefore, whether the bass is boosted during recording or not, the playback level at the head at, say, 50 cps., will be more or less the same and the hum-to-signal ratio will not be affected.

In passing, there is a point about the "flat playback amplifier" idea. Each type of head and, indeed, each head of an individual make, has its own turnover frequency and resonance and though it is easy to standardise on a record characteristic, the only way to standardise playback characteristic is to equalise each head separately.

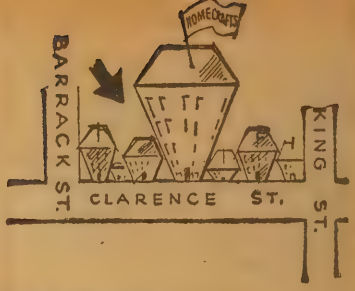
Regarding your musings about the possibility of damaging heads, long before the copper became hot, the tape would have had convulsions, and before that happened, the core would be as saturated as a sponge dunked in spirits.

As a matter of interest, it is possible to feed enough bias current into the head to melt the solder which holds it together. But this requires more watts than the average oscillator can supply and even to approach this power in recording would be absurd. Incidentally, the iron gets much hotter than the copper.

At the lowest frequency, about 20 watts might burn out the windings, given enough time.

The answer to your question re the use of a swamp resistor to protect the head is emphatically no. The only case of a burnt-out head which I have personally encountered was the result of a friend connecting one across the mains. It was a new and expensive head and he has never been quite the same since. Nor has the head. (P. D. Thomas.)

NEW! from Homecrafts



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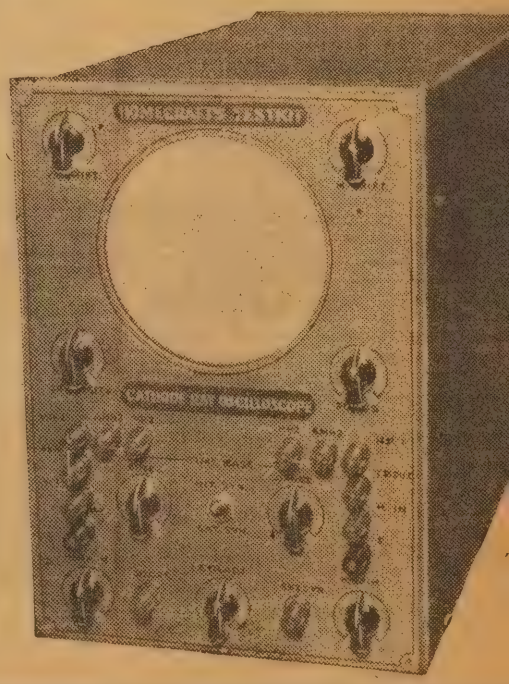
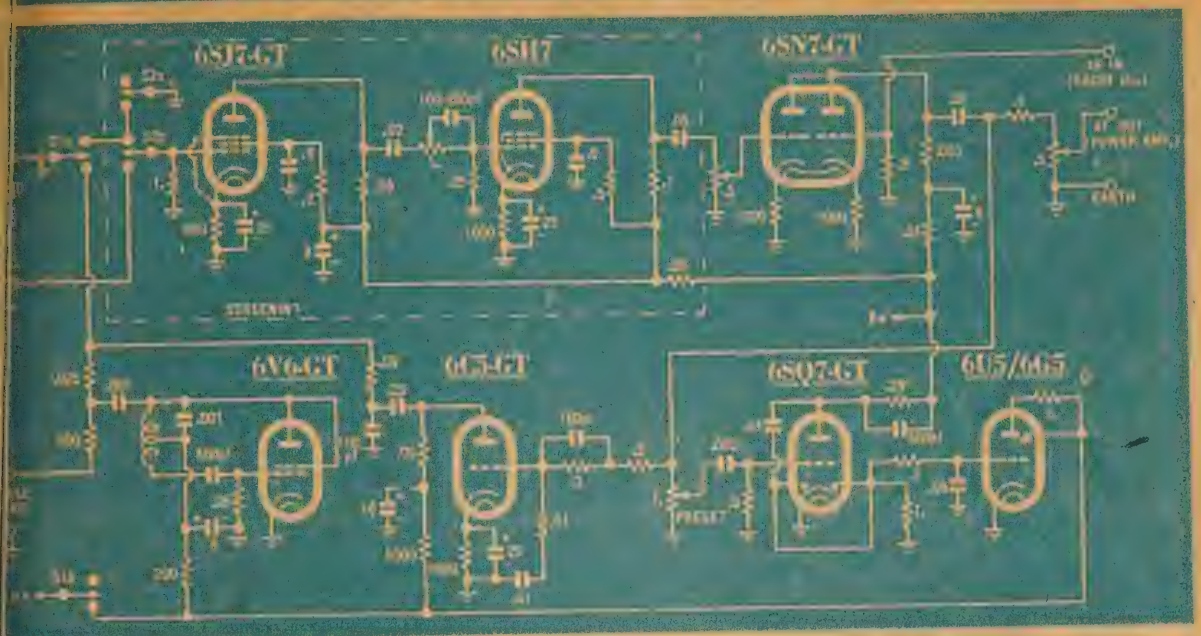


We wish to correct any misunderstanding regarding the Oscilloscope Kit as illustrated. It does not include the following:—

Mu—Metal Shield and front mounting collar.

These items are unprocurable owing to import restrictions.

ANOTHER CIRCUIT SUGGESTED BY Mr. THOMAS



Mr. Thomas is a tiger for punishment. After the arguments which his last circuit produced, he submits details of the equipment at present in use. It is intended to be coupled to an existing basic amplifier having the necessary fidelity and power output.

eries about burn-outs is more ely to come as a result of accident ther than intent.

To change the subject . . .

Just by way of a little variation, ve you ever thought of the ap- rent conundrum posed by ampli- rs having an extremely low appar- t value of output impedance. In ct, to make it better still, think an amplifier which has just enough gative and positive feedback ap- ied to reduce its effective output npedance to zero ohms.

In other words, its output impe- nce is equivalent to a short cir- it.

At first glance, that may not cause y immediate apprehension, but how n you have a potential across a vice which has absolutely no in- rnal resistance. You remember at I said "zero internal impedance."

VHAT WOULD HAPPEN ?

In case this thought doesn't regis- r either, consider what would hap- n if you were to remove the nor- al loudspeaker load from the out- ut terminals of the said amplifier nd bridge them with a short length copper wire. Now feed in a sig- al of some description.

Would you now expect an infinite rrent to flow through the shorting nk? The wire to go suddenly red nd melt into smoking little droplets copper? It should you know, if e amplifier really has zero output npedance.

But any piece of copper wire wor- y of the name wouldn't melt and mebody's kidding somebody.

Now, take it a step further, and ssume that the feedback has been gged to produce a negative output mpedance. There are such ampli- ers, you know, but try to repre- ent them with conventional equiva- ent circuit diagrams!

Imagine trying to draw an electrical generator and its load in the conventional manner, then trying to include in the circuit a quantity which you have to imagine and designate as "minus R."

Imagine a progressive reduction in the value of the load, "R," with the generator striving all the while not only to sustain its output volts, but actually to increase them. What happens then, when the load resistor drops to zero?

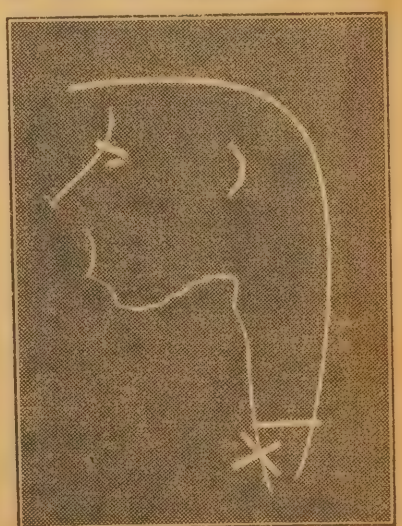
Does the current from the negative output impedance generator build up to a figure in excess of infinity (that would be really something) or does something go amiss with the reasoning.

It does. But what? .

I didn't need to invent these questions because they have actually been asked of me several times. They'll give you something to think about while lying awake at nights!

COULD THIS THING BE A GREMLIN?

Too much "Synch.", while testing a tape amplifier, produced this pattern on the CRO screen.



We summoned a photographer at once. A few pieces of matchstick, laid on the print, completed the picture.

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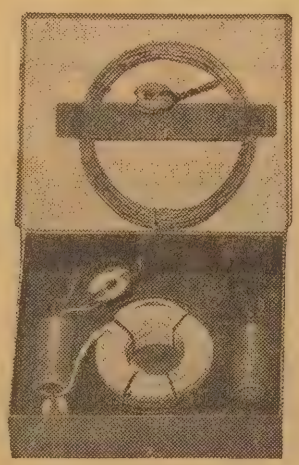

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USING STANDARD SIGNALS FROM U.S.

ossibly not all readers realise that very precise standards of time and frequency are available n the short-wave bands to anyone possessing a suitable receiver. This paper, prepared by ngineers of the Aerovox Corporation, summarises the present transmissions and suggests methods by which the information can be used.

E standard time and frequency transmissions of the National au of Standards radio stations V and WWVH provide an in- able service to laboratories and vidual experimenters through- the world.

xtremely precise audio and radio uency standards, as well as rate time intervals and radio uency propagation warnings, are ed at the disposal of anyone ing a receiver capable of tun- to one or more of the trans- ing frequencies.

ANSMISSION SCHEDULES

he proper use of these facilities be made to greatly supplement instrumentation of any labora- y. However, the maximum utili- on of this valuable "natural re- rce" depends upon a knowledge the broadcasting schedules, trans- ting frequencies, and suitable thods of comparison.

he standard frequency stations WV and WWVH are operated by Central Radio Propagation Lab- atory of the National Bureau of ndards. Station WWV is located Beltsville, Md. (near Washing- , DC), and WWVH is on the and of Maui, Hawaiian Islands.

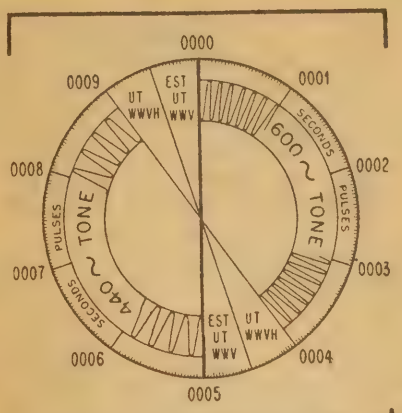
Both stations broadcast continu- sly on the carrier frequencies and th the output powers shown in ble 1. This diversity of geo- aphical location and transmitting equencies places the services of se stations on an essentially rld-wide coverage basis.

The standard carrier frequency nsmissions of WWV and WWVH e modulated with various stand- d audio tones and time interval nals in order to provide calibra- n information for a wide variety instruments.

ANDARD AUDIO

During the first four minutes of ch five minute interval, starting the hour, the carriers are modu- ed by accurate sinusoidal tone nals; 600 cycles per second is ed during the first four minute riod, followed by 440 cycles dur- g the second period, &c. These o audio frequencies are alternat- each five minutes throughout the ur.

At the beginning of the fifth min- e of each five minute interval, e tone modulation is interrupted exactly one minute during which tion identification is given in ice from WWV and in Internat- nal Morse Code from WWVH. Also during this minute, Eastern ndard Time is announced from WV in voice, and Universal Time sent in code from both stations. During the entire transmission, a e-millisecond (.005 second) pulse nal is superimposed upon the car-



WWV-WWVH TEN-MINUTE TRANSMISSION CYCLE

FIG. 1

rier. This pulse consists of five cycles of a one kilocycle sine wave and is heard as a sharp "tick" which accurately marks the passage of each sound.

This "seconds pulse" is omitted on the 59th second of each minute to accurately identify one minute intervals. Figure 1 illustrates the transmitting cycle of WWV, which is repeated every 10 minutes, starting on the hour.

In addition to the standard time and frequency transmissions, WWV also broadcasts radio propagation disturbance warning notices for the benefit of commercial services and amateurs whose communications depend upon conditions in the ionosphere. These announcements are made in code during the 19th and 49th minutes of each hour.

As of July 1, 1952, the system was revised to include not only the transmission of a symbol to indicate the present ionospheric conditions affecting communication paths over the North Atlantic, but also a numeral to indicate the condition forecast for the next 12 hours.

TABLE I

FREQ. (MC.)	POWER (KW.)
WWV	
2.5	0.7
5	8.0
10	9.0
15	9.0
20	8.5 *
25	.1
WWVH	
5	0.4
10	0.4
15	0.4

* *Reduced to 0.1 KW. for first four work days following first Sunday of even months.*

CONDITIONS

Thus, the letters "N," "U," or "W," sent five times in code, mean that the present radio reception conditions are "normal," "unsettled," or "disturbed," respectively, while a numeral which follows each letter indicates that the forecast for the next 12 hours is for conditions to continue as follows:

Forecast Numeral Propagation Condition

1. Impossible.
2. Very poor.
3. Poor.
4. Fair to Poor.
5. Fair.
6. Fair to Good.
7. Good.
8. Very good.
9. Excellent.

According to this system, the characters "W7" transmitted from WWV would be interpreted to mean that the present ionospheric conditions affecting radio propagation were "disturbed," but expected to improve to "good" within the next 12 hours.

The accuracies of the audio and radio frequencies and other information broadcast by stations WWV

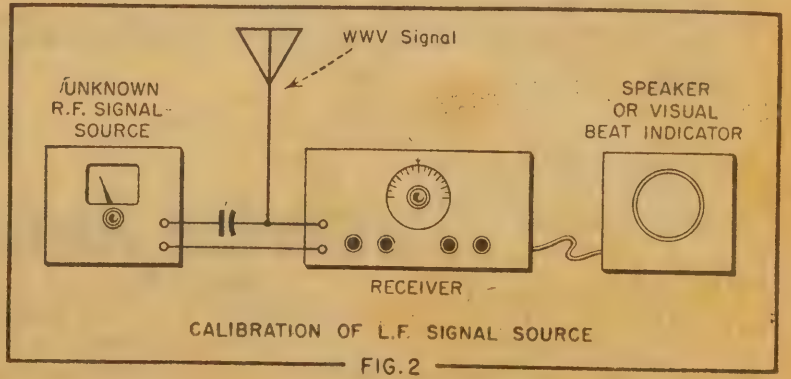


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FIG. 2

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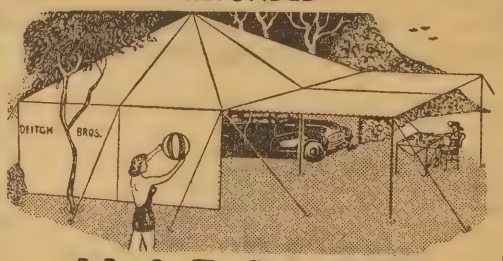

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12 x 18	£13	5	3	18 x 15	£17	13	9
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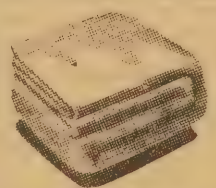

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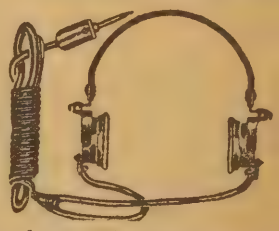
HEADPHONES



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S.A.E. Set Spanners: 1/4 x 5-16, 5/ 7-16, 1/4 x 9-16, 5/8 x 9-16, 3/4 x 5- 15-16 x 1.
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S.A.E. Socket Spanners: 7-16, 1/4, 5- 9-16.
One 1/2in. Drive for Sockets.
One 10in. Shifting Spanner.
One pair of 7in Insulated Pliers.
One pair of 6in Nippers.
One Metal Tool Box, 14in. x 7in. 4in.

The Lot, £8/11/-

Freight payable at nearest attende Railway Station.

WWVH are as great as the state of the engineering art ermit. All frequencies trans- from both stations are accur- within two parts in 100-million. iscussion of the means em- to insure this precision is eral interest and aids in gain- appreciation of the meticu- are required to maintain the al primary frequency stand-

carrier frequencies at WWV erived from the average of precision quartz crystal os- rs which are operated con- sly. These oscillators all op- on 100 kilocycles per second battery power and are housed bterranean vaults 25ft below arth's surface.

temperature and humidity of vaults are very carefully con- d to insure maximum frequency ity.

frequencies of the oscillators compared continually among selves and are checked against asic frequency standard — the d of the earth's rotation.

ITROL SYSTEM

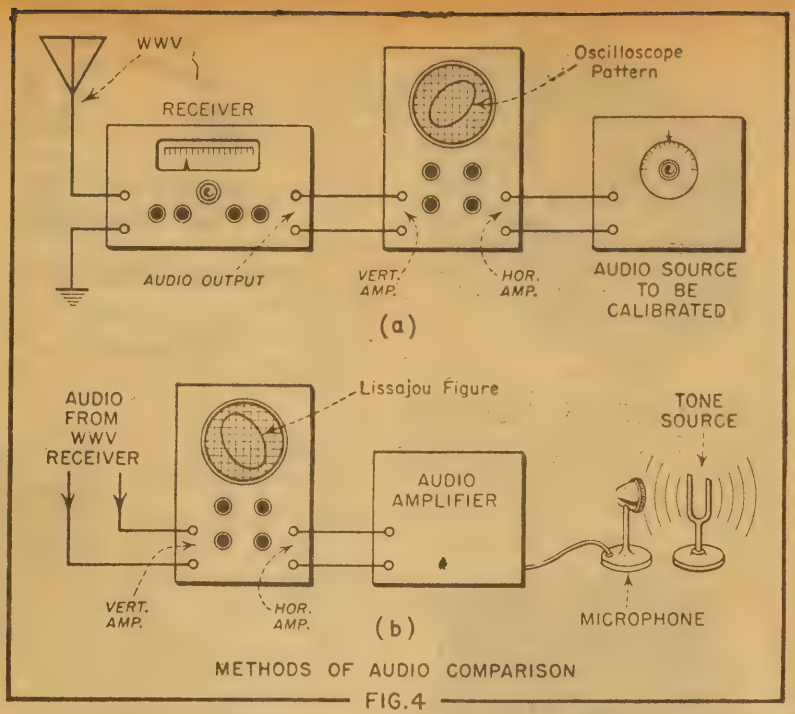
e "control standard" oscillator n is chosen to control WWV s a chain of frequency dividers multipliers which convert the mental 100 kc. frequency to de variety of standards ranging one cps. to 30,000 mc.

radio and audio frequencies dcast are thus derived from one ator and are therefore of com- le accuracy.

e 60 cycle standard is used to a synchronous clock motor n allows the standard to be ed against Naval Observatory In this manner, the time sig- as broadcast from WWV agree Naval Observatory time to n several hundredths of a d and have a diurnal variation n never exceeds 2-millionths ds.

e frequency standards at VH are similar to those used VWV and are maintained in ment with WWV signals to n two parts in 100-million by arison. These comparisons are during the four minutes fol- g each hour and half-hour WWVH is off the air and g 34 minute interruptions n occur at 1900 hours GMT.

m most points in the contin- United States, the standard ency broadcasts of WWV can eceived on a relatively simple ver. One of the superhetero- type having good selectivity automatic volume control is to referred, however. These fea-



METHODS OF AUDIO COMPARISON

FIG.4

tures are usually found in communications-type receivers.

Under normal propagation conditions, such receivers are capable of receiving WWV or WWVH transmissions on several of the standard frequencies, thus permitting good flexibility of measurement.

The simplest and most direct way of utilising standard frequency transmissions is the use of the transmitted signals as check points to calibrate the dial of a receiver. The variety of transmitted frequencies usually insures that one WWV signal falls within each tuning range of multi-band receivers.

DIAL CALIBRATION

The accuracy of the receiver dial calibration may then be checked against the standard frequency carrier and any serious deviation corrected by adjusting either the receiver dial mechanically, or the receiver local oscillator trimmer.

In all cases, the receiver should be allowed to reach thermal equilibrium before comparisons are made.

Figure 2 illustrates a method of comparing the frequency of tunable signal sources such as signal generators, grid-dip meters, and amateur VFO's with the WWV standard. The method is also applicable to fixed frequency standard oscillators which operate close to some submultiple of a WWV carrier frequency.

The signal source to be calibrated is loosely coupled by radiation or capacity coupling to the WWV receiver, which is carefully tuned to an appropriate WWV signal. The frequency of the signal source is then varied until a beat note between one of its harmonics and the WWV carrier is heard in the receiver output.

When the local signal is adjusted to produce zero beat, its frequency is exactly equal to that of WWV or is an exact submultiple of it.

If the device being checked has an approximate calibration, the order of the harmonic is easily identified. Otherwise, the fundamental frequency of the unknown source can be found by determining the frequency difference between two adjacent harmonics on the receiver.

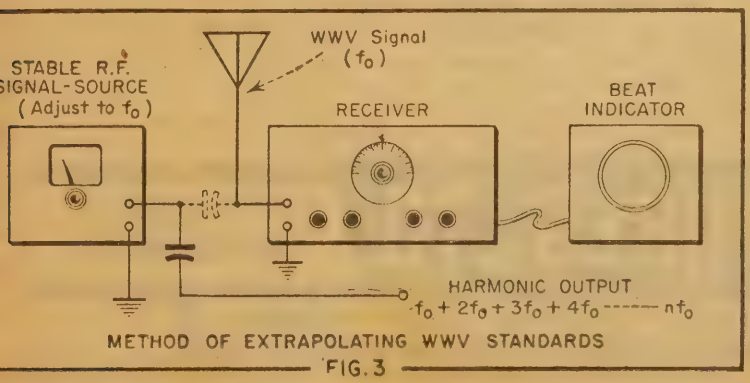
BEAT NOTES

Thus, a one megacycle signal will produce a beat with the five megacycle carrier of WWV and will also be heard at four and six megacycles on the communication receiver, while a .5 megacycle signal will beat with the five megacycle carrier and will also be heard at 4.5 and 5.5 megacycles. This makes it possible to obtain many check points which will be highly accurate as long as the integral multiple is maintained at zero beat with WWV.

A visual beat indicator, such as an audio output meter across the receiver output, is usually more accurate than the aural method.

When it is necessary to provide standard check points at frequencies considerably higher than the highest available WWV carrier, the arrangement shown in Fig. 3 is employed. In this method, a tunable RF oscillator of suitable frequency stability is zero beat in a receiver with the WWV standard.

Continued on next page



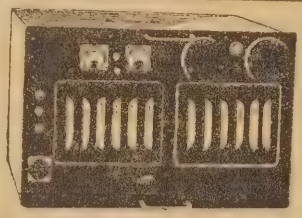
METHOD OF EXTRAPOLATING WWV STANDARDS

FIG.3

RADIOGRAM CABINET

Specially selected walnut veneers are used in the construction of this full-sized radiogram cabinet. Any standard-sized chassis and record changer or single-unit motor can readily be fitted. Panels are uncut. Ideal for the home set builder.

Price 15 gns.

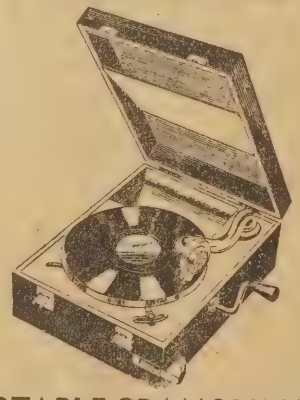


AT 300 TRANSMITTERS

Radar transmitter uses the following parts:— 2—AV11 valves, 2—cyclatron valves,: 2—4 ceramic socket, 1—24 volt motor, 2—01-5000 volt working condensers, 1—02-10,000 volt working condenser, 1—001-5000 volt mica condenser, 3—Heavy Duty transformers, 1—0-100 volt AC meter which is 0-1 MA movement with 1 MA dry metal rectifier fitted, 1—0-5 MA, D.C. Meter, and many other parts, such as stand off insulators, coils, etc. Worth £20.

Our price £4/19/6

Weight 80 lbs.



PORTABLE GRAMOPHONE

In leatherette-covered case. Wind up type portable gramophone. Ideal for the holiday season. Good tone, using best brand of English motor.

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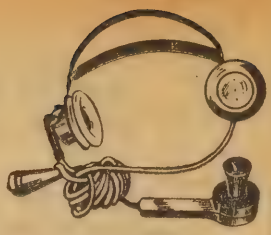

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Headphone and microphone sets for high fidelity work, robust in construction, phones are equipped with velvet ear pads.

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Reduced to 30/-.

Job line of ISO core transformers for 8in, 10in, or 12in Speakers in 5000 OHM impedance. Usual price 13/8.

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Morse Practice Sets. Excellent for learning Morse Code, made in England. Complete with battery. Worth 45/-.

Our price 18/6 each

Morse Buzzers as used in Army. Don-5 Telephones. Ideal for Morse practice sets, &c.

Price 4/6 each

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All parcels sent registered post unless otherwise stated. Postage or freight must be included with order.

RECORD PLAYER

This record player uses a well known brand of English Electric Motor, and a good English magnetic pick-up. The unit has 2-pin socket for A.C. Connection and shielded lead pick-up. It is extremely light in weight and is beautifully finished in brown or black leather cloth.

Price £9/10/-

WIRE WOUND RESISTORS

Available in the following sizes:

Wattage	Resistance	Price
10	750	1/-
10	500	1/-
10	1500	1/-
10	175	1/-
5	1500	1/-
10	1250	1/-
10	300	1/-
20	50	2/-
1	25	1/-
12	5500	2/-
25	3500	2/6
20	850	2/-
40	100	4/-
25	1000	2/6
85	40	5/-
30	3750	2/6
25	15,000	2/6
10	450	1/-
10	50	1/-
10	2500	1/-
20	5000	2/-
20	12,500	2/-
55	7000	4/-
55	3000	4/-
85	2500	5/-
20	700	2/-
10	50	1/-
25	3000	2/6
27	500	2/6
20	250	2/-
20	4000	2/-
55	5000	4/-
12	5500	1/-
55	10,000	4/-
30	4000	2/-

Also available 20 watt. wire-wound resistors in the following sizes—priced at 2/- each. 50, 75, 100, 125, 150, 175, 200, 250, 300, 400, 500, 750, 1250, 1750, 4000, 7500, 17,500.

25 Watt. Wire-wound Resistors

In the following sizes at 2/6 each 50, 75, 100, 125, 175, 200, 250, 300, 400, 500, 750, 1250, 1500, 1750, 3000, 4000, 7500, 12,500.

Watt.	Resistance	Watt.	Resistance
10	125	12	14,200
16	7000	12	5500
12	800	12	5000
12	4500	16	80

All at 2/- each

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inued from previous page)
harmonics of this oscillator
en appear at precisely in-
ultiples of the standard fre-
to which it is referred.
auxiliary oscillator has suf-
power output, these harmon-
extend quite high in fre-
and may be used as "mark-
roughout the VHF and lower
egions. In one method a
oscillator of conventional de-
adjusted to operate at zero
ith WWV and supplied with
ed DC to enhance the har-
content. A secondary stand-
some type will usually be
d to identify harmonics.
ronic audio equipment, as
musical instruments capable
ained tones, may be referred
440 and 600 cycle tones
ast by WWV or WWVH by
of the layouts illustrated in
For audio oscillators and
equipment having an electrical
signal, Fig. 4a is employed.

NECTIONS

output of the WWV receiver
control and beat frequency
tor off) is coupled to the am-
feeding one set of plates
oscilloscope, while the output
e device being calibrated is
ed to the amplifier feeding the
set of deflection plates. When
equency of the local source is
ted to equal the audio tone
transmitted by WWV, a
nary circle or ellipse will
ar on the cathode ray tube.
ner integral multiples or sub-
ples may easily be identified
neans of the Lissajou figure
aced. A description of the use
issajou Patterns may be found
ny engineering text.
calibrate the musical pitch pro-
d by non-electronic sources, the
pment shown in Fig 4b is re-
ed. Since the source does not
uce an electrical audio output,
icrophone and suitable audio
lifier must be used to convert
audio output of the device into
electrical signal for comparison
that received from WWV.
s in Fig. 4a, the frequency of
unknown source is identified by
oscilloscope pattern produced.

HOW TO USE YOUR OSCILLATOR

(Continued from Page 33)

nment, there is another very val-
le use for the instrument. Have
ever built a new receiver and
covered, when it was finally
tched on, that it stubbornly re-
ed to utter a sound? If you have
probably know just how helpless
feels without any means of test-
the various stages in an effort
track down the fault.
This is where a modulated oscil-
or can be extremely valuable and
s little unit is no exception. It
ovides enough output to deliver a
nal to the speaker through a nor-
l audio channel when connected to
e second IF secondary or the diode
ate to which this normally connects.
nilar results will be obtained when
is connected to the primary side
the plate of the IF valve.
If signals can be obtained from this
int it will indicate that the second
transformer, detector circuit, and

(Continued on Page 91)

BRAND NEW
BARGAINS
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CONDENSERS. Block type 1 mfd 400 volts working 2/-
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RECTIFIERS. Copper oxide bridge type 48 volt. 100 mA. .. 4/6
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METERS. 2½in Square face. 0-1 mA. English make. 30/-
RESISTORS. Heavy duty. 150 ohms, 16 watts 1/-
HEADPHONES. Army type low resistance with cord and plug 10/-
GENEMOTORS. Command type. 250 volts 60 mA. Input 28 volts 27/6
CONNECTORS. Jones type 8 pin plug with socket 3/6
VALVES. Type 15. 2 volt battery triode with cathode 2/-
POTENTIOMETERS. 0.5 megohms. A well known brand 2/6
CONNECTORS. 26 pin plug with socket 5/-

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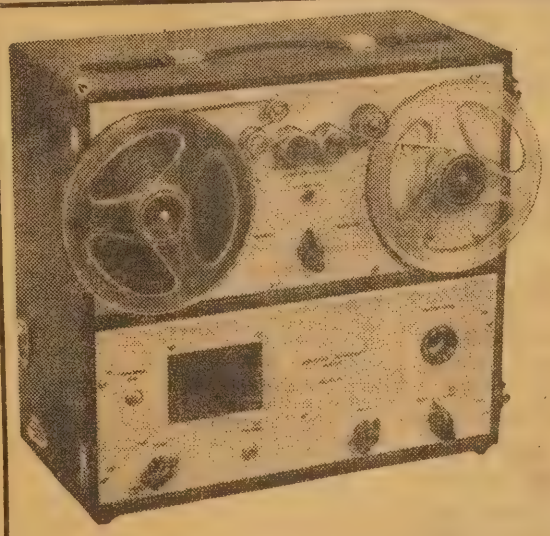

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One problem that apparently faces many of our readers when overhauling their equipmen whether or not to buy a record changer. Frequently we are asked to advise on this point. well as whether record changers are good things or bad things. These aren't the easi questions to answer.

By JOHN MOYLE

AS a matter of fact, I don't know whether I would like to give a firm answer on the matter of record changers for two reasons.

The first is that I have never had the opportunity to carry out enough tests to compare their performance. The second is that whether record changers are good or bad depends largely on how badly you want one.

A record changer consists of a fairly complicated mechanical system of levers, cams, &c., which perform the task of stopping and starting the motor, raising and lowering the pick-up on the record, releasing the records one by one from the magazine and so on. Anyone who has inspected this mechanism knows what a mass of bits and pieces it is.

Some of the more elaborate changers have devices which automatically start the pick-up in the right spot for 10 and 12-inch records even when mixed together.

It's only to be expected that such a device is liable to break down at times, mainly because adjustments and tensions have to be maintained to fairly accurate tolerances which will alter in the ordinary course of wear. I have heard of people using the same type of changer, some of whom have never had any trouble, and others for whom the thing just wouldn't behave almost from the word go.

This mechanical complication, therefore, is something which is rather unpredictable in a changer, and although reliability has been improved a great deal in late models, it has caused users and manufacturers plenty of worry in the past. The more complicated the changer, the more we might expect maintenance to increase.

Does this make a changer good or bad? I don't think it does really, because it must be related to your requirements. If the facility of playing stacks of records without interruption is something you must have for dancing for instance, you may be quite prepared to consider maintenance part and parcel of getting what you want. Even cars have punctures and ignition failures, but we don't condemn them for that.

EFFECT ON RECORDS

So that, apart from the general observation that cheaply made articles in this world are generally not as reliable as better quality, more costly jobs, perhaps at the moment we'd better leave it at that. I'm not in a position to advise more specifically on the mechanical merits of the various types that are available.

Do changers harm your records? I think it true to say that no changer has yet been invented which will handle your records as safely as you might do by hand, taking them carefully from the folders by the edges, keeping anything but the stylus from touching the surface, and just as carefully replacing them when finished.

Some changers have very smooth engagement of the pick-up with the first grooves of the record, and most of the extra wear if any is taken by the run-in grooves. Some even silence the pick-up so that you won't hear the noise of these grooves. If the changer is not properly adjusted, however, it can drag the stylus over a groove or two, and will almost certainly do so with older records which don't conform to the physical standards of start and finish later discs.

So at least it will be import see that the initial adjustment i rect and that you know how adjust this matter should it b quired.

All changers I have seen d stationary disc on top of a m one each time a change is made I think must impose more than inary surface deterioration on t cords themselves. There is a c buffer action due to the cushi air which builds up as the r falls, if it falls squarely, but th still the friction which takes as the new disc speeds up, in tion to the rubbing between already on the table, and those w are loaded on the magazine.

SPECIAL PRECAUTION

Some records, notably the ne rpm types, have a raised edge w prevents the playing surfaces normally coming into contact, but isn't generally true of 78's.

But if the records are pop types which have a comparati short interest life, extra wea this type might not be important would be important with records value and hope to keep for years

So much for general wear. W about the stylus tip, and the ha ling it receives? This is someth which varies greatly between cha ers, and also with the adjustmen individual changers. Some we h seen dropped the arm so accura that the tip hit the disc with ha a bump. Others operated so rou that the stylus itself became b after a period of operation with m detrimental effects of wear and production.

Sometimes such a changer chip the jewel point. If this dam is not noticed, heavy wear can t place on a number of records bef a new stylus is fitted.

BASIC REQUIREMENT

The standard three-speed chang which is operated by tripping mec anism at the beginning and end a record must use a pick-up with certain amount of weight and sti ness, neither of which are co sistent with the requirements really high fidelity. On the oth hand, the user of a record chang may not necessarily demand a stan ard of reproduction essential to t epicure. In fact, this is more like to be so than not.

It is probably true, therefore, to s that the average record chang should in the first place be of reputable make, and bought with t assurance that suitable service facil ties are available should they needed. The changer will be som what harder on records than if the are changed by hand, and the pic

Two speeds, 33 1-3 or 78 r.p.m. Full 12in Turntable. Main spindle, precision ground and lapped, runs in phosphor bronze bearings. Virtually vibrationless, synchronous motor.
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d with the changer will prob- of the medium fidelity rather ne high fidelity type. All nings will vary according to and price, just as they do ything else.

nally I think the changer will in the future boil down aight choice between 33 and eds, no need to change the at present by rocking or turn- ethods, and probably consid- mprovements in engaging the ue to the lighter weight pick- improved triggering methods. feature of the modern 45 hanger I like is the large hole of two inches in diameter. hangers operate by threading ords on a spindle through the of which a small pawl operates hem drop, one by one. Con- use inevitably enlarges the hole, which doesn't help mat- bit.

ne older type 78 type changers her not comment. Some of weren't too bad, but many of were shockng.

RECORDS

e are no doubt many readers some experience with record ers who would like to tell me of xperiences. After all, in assess- e general reliability and per- nce of any device, it isn't a bad o ask the man who owns one. ld like to hear from any such s, and from their letters some cal picture might emerge which benefit us all.

ing the month I have been g some of the latest Austra- nade LP records, and have them of really good quality. ey have come from three dif- companies, this looks good. It s that at least the first hurdle een overcome, that of satisfac- LP pressing in Australia. All ecords I have played have had surfaces, reasonably free from and other extraneous noises. uld not say that in appear- they are all quite the equal e best imported, but this does eem to have any great effect eir performance.

stminster are responsible for the Bach Brandenburg Concerto 2 in F major, and No. 4 in G r, and Beethoven's Pastoral phony played by the Vienna Opera Orchestra under Her- n Scherchen.

H WITH RECORDERS

e Bach records are bound to be d with particular pleasure, for include recorder flutes, some- g I do not remember hearing re in music of this type. A light in the bass, I wouldn't them on this, although I liked n best with some reinforcement. recorders are beautifully play- balancing well with the remain- of the orchestra. The record echnically clean—one you will many times on its all round it.

ne Pastoral is quite the best rding I've heard so far, even if performance lacks its full shape ve have it in Toscanini's famous s. To play them together for parison is to show how immeas- bly superior are these modern rdings from every point of view. was particularly struck with clear outlines of individual in- ment and orchestral sections without loss of their essential cohesion as a body. The playing may not be brilliant, but it is exceedingly competent.

Nixa have released a beautiful record of the Schubert Trio in B flat Op. 99, played by the Carnegie Trio. The only criticism I have of this record is that on wide range equipment the violin isn't quite clean in the upper harmonics. On the average gramophone, or played with a slight top cut, this effect is eliminated without seriously affecting the result. We then have a really fine performance and recording of one of Schubert's loveliest works. Piano and 'cello tone, general balance, and presence are all first rate. I'd give it very high marks.

(Continued on Page 96)

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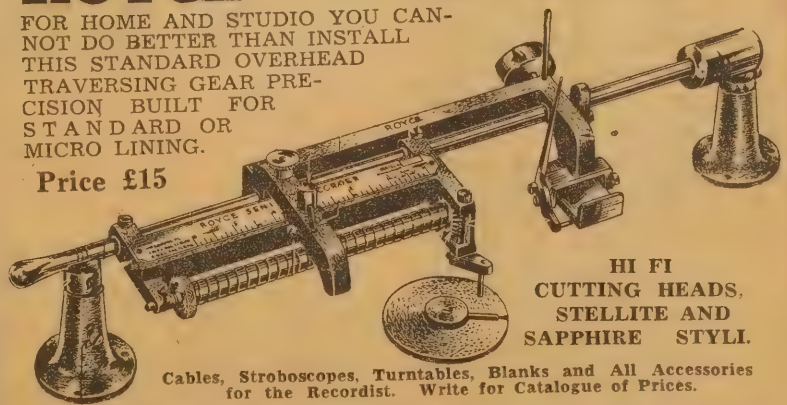

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SHORT-WAVE NOTES BY ART CUSHE

REPORTS FROM CP38, LA PAZ, BOLIVIA

A long letter of thanks, and appreciation for the reports from Australian and New Zealand listeners, is to hand from David B. Phillips, Director of, CP38 in La Paz.

LISTENERS will recall that CP38 conducted a series of tests last September, and though beamed northwards on this frequency of 9505kcs, reception was also good in this area. CP38, transmits from La Paz, Bolivia from an altitude of 13,000ft, and uses the slogan "The Southern Cross Radio."

The station is operated by the Canadian Baptist Mission in Bolivia, and is a non-commercial station, with cultural, religious and educational programs.

Programs are transmitted in Spanish, and the schedule of the station is Sunday 9.55-11.15pm, 2.00-6.00am (Monday), weekdays 8.55-10.15 pm., 12.30-3.30 am, 8.55-noon, except on Tuesdays when they are silent. The address is Cajon 8, La Paz, and the station is affiliated with the Panamerican Cultural Network. BBC and Voice of America programs are also relayed.

FROM THE MAILBOX

Venezuela-YVMS (4850) "Radio Universe," Apartado Postal 67, Barquisimeto, Venezuela, verifies by airmail letter from the Director. YVMS signs on at 8.30 pm.

Sao Tome-CR5SC, 4807kcs, Sao Tome, verifies with a card showing a map of this small island, off the West African coast. The only other frequency listed is 17677kcs, with the call CR5SB. The station is operated by the Radio Club of Sao Tome.

NIGERIAN NEWS

RAPID progress has been made by the Nigerian Broadcasting Service, since we first heard this station in December 1949, when they had just commenced an experimental service on 9665kcs, using an old Air Ministry 300 watt transmitter.

Plans just announced show a big increase in transmitter power during this year, and the use of new regional stations. Lagos (National), 6100kcs (300w) 3.00 pm-8.00 am 4975 (7500w soon to be 20,000w 8.00-11.00 pm, 4933 (300w) 2.00-6.00 am. Kaduna (North Regional), 3300kcs (300w to be increased to 7500w) 2.40-7.45 pm, 2.15-3.00 am, 7170 kcs 8.30 pm-2.00 am, Enugu (East Reginal) 7097kcs, 3.00 pm-8.10 am (Sunday), 8.00 pm-8.00 am (weekdays).

Power is 300w soon to be increased to 2500w. The Nigerian Broadcasting Service, Broadcasting House, Lagos, Nigeria, is the address for reports, which are appreciated.

RADIO JAMAICA

BROADCASTS from Radio Jamaica, are now carried on two frequencies, 4950 and 2330 kilocycles, on short-wave. Jamaica has commercial programs, and operates from 9.00 pm-11.00 pm, 11.30 pm-8.15 am on 4950kcs ,and 8.30 am-2.00 pm on 2330kcs. On Sundays the sign on is 10.00 pm, and sign off at 2.05 pm (Monday). BBC news is carried 2.00 am, 6:00 am, 9.00 am, noon, while local news broadcasts are aired at 10.30 pm, 3.30, 9.10 am, 12.10 pm. Other programs included BBC and American transcriptions used for commercial sessions. Radio Jamaica, is located at Broadcasting House, 32 Lyndhurst Rd., Cross Rds., Jamaica, British West Indies and uses 5000 watts. The broadcast band frequency has been moved to 670kcs from 880kcs.

DIGEST OF DX TIPS

kcs.	Call and Location	Time Heard.
6170	OBX4B, Cerro de Pasco, Peru.	8.00am-2.30pm.
7300	Athens, Greece.	English news 7.30-7.45am.
9710	Djakarta, Java.	News to Australia 9pm.
9900	Omdurman, Sudan.	English to 4.00am. Saturday.
11795	Hamburg, Germany.	To Far East 8.15pm.
11925	CE1190, Santiago, Chile.	Closes 2.10pm.
11950	YSAXA, Managua, Nicaragua.	Sign off 4.00pm.
11972	TIHH, San Jose, Costa Rica.	Fair strength 3.30pm.
15190	OIX4, Helsinki, Finland	English news 10.00pm.
21740	Vatican City.	French broadcast 5.15pm.

NEW BBC FREQUENCIES

THE use by the BBC of 17890kcs, which was reported in recent issues, has been made in agreement with the British Post Office, who use this channel. The frequency was used for a few days for tests with Singapore, and proved successful. It is expected that the British Far Eastern Broadcasting Service, in Singapore, will use this frequency shortly. The latest BBC frequency lists show three new ones added to the Corporation's list, MCR on 9760kcs, MCS on 7110kcs and MCP 9735kcs. This makes a grand total of 94 frequencies which the BBC can use in the varied short-wave Services it transmits.

NOTES for the next issue close at 212 Earn Street, Invercargill, New Zealand, on March 7th. Times used are Australian Eastern Standard Time.

COSTA RICA. — TIDCR (formerly TIPG) "La Voz de la Victor" in San Jose, is verifying with a new card, according to "Radio Amateur." TIDCR is owned by Radiodifusora Diario de Costa Rica Ltd. Apartado 3611, San Jose. TIPG was a popular broadcaster of many years standing, and using a 2000w transmitter, operates 10.00 pm-2.00 pm. We expect that this station will be heard during the coming winter. At present the frequency is used by VLW9, Perth, at 10 pm making reception very difficult.

YOUR OPPORTUNITY

to join the world-wide ranks of amateur transmitters! The Wireless Institute of Australia holds regular classes in Sydney to assist Sydney and suburban enthusiasts to obtain their Amateur Operators Certificates of Proficiency.

Write for particulars to the Class Manager, W.I.A., Box 1734, G.P.O., Sydney.

FLASHES FROM EVERYWHERE

COSTA RICA.—TIHH "Radio Athenea" Apartado 2208, San Jose, is at present received at good strength 11972kcs at 2.30 pm. This station with a coloured postcard view of local scenic attraction.

ECUADOR — HC4AS "La Voz de Caras," Bolivar, Ecuador, operating 4203kcs was heard last winter by listeners in this area, usually on Sunday to after 5 pm. The identification is never certain, as some announcers appear to make the location as Caracas, Venezuela, but the station has been identified as the above ,according to a recent issue of the "Universalite." The program usually consisted of dance music while identification and time announcements were heard on the hour and half hour.

FRENCH GUIANA. — Ici Cayenne, Radiodifusion Francaise, Cayenne, French Guiana, commenced broadcasting in March 1951, but wasn't heard by European listeners till last November. Verification from the station, quoted in ISWR stated the station operates on 6198kcs, with 100 watts . Schedule is Thursday, Sunday 9.00-10.00 am, but they have been on daily now. They used 6600 and 6100kcs before settling on 6198kcs.

VATICAN — Vatican Radio has been reported by Rex Gillett, Adelaide, using a new 13 metre band frequency 21740kcs, with a French broadcast at 5.15 pm. This is a very early time for such high frequency reception, but listeners should be able to hear the broadcast for the next few weeks while the summer high frequency DX record fades out.

REUNION. — Radio St. Denis, Reunion in this French possession ,operates on 7168kcs, from opening at 12.15 am. Signals are fairly good, but at 12.25 am a Russian transmitter opens on the frequency and blots out further hope of hearing the Reunion transmitter.

INDIA. — Delhi using 16 metre frequencies, 17705 and 17760kcs has English news at 5.00 pm, beamed to the East. News is again carried at 6.00 pm. Nearby Radio Pakistan, operates on 17710kcs frequency at a slightly weaker strength, with news at 6.30 pm, the location of this transmitter is Karachi.

BRAZIL. — New stations, which seem to be a very frequent happening in this radio minded country, include Emissora Continental. Niteroi, Brazil, PRI-6 6195kcs, 2000w. Radio Cruzeiro do Sul, Rio de Janeiro, PRD22, 11735kcs. 20,000w. Callsigns for the Radio Jornal do Commercio Recife, have been announced. The new ones are ZYK32 (11825) and ZYK31 (6085).

CHINA. — Radio Peking, has been noted on two new frequencies. At 9 pm they sign on using 1760kcs, with a Chinese language program. Radio Australia reports Peking as using a new outlet 7532kcs to sign off at 3.30 am; in conflict with 7500kcs. The other Peking frequencies, 6100 and 6050 have been operating at 4.30 am. Peking's English broadcasts are heard at 7.00 pm on 11680, 6100; 11.30 pm on 11680, 15060 and at 8.30 am on 11680 and 15060kcs.

AUSTRALIAN DX [illegible] CALLING—New Schedule

RADIO Australia's DX session, compered by Graham Hutchins, is now being broadcast on Sundays as follows.

2.00pm, To West Coast, USA 15200kcs.

3.30pm, To Africa. 15200kcs.

6.00pm, To NZ, Europe. 9580 11760kcs; To Asia 17840kcs.

11.40pm To East Coast, USA 11840kcs.

HE HAM BANDS WITH BILL MOORE

y amateurs obtain great pleasure from operating in the various DX Contests conducted ugh the year. Portions of two of the more popular contests will be held during March. Pro- ation conditions are still poor and competitors will have to spend many hours to record good scores.

6th Beru Contest, 1953, will be wn as the Coronation Year Beru and will be conducted during and April.

Telegraphy section will be run :00hrs, GMT, March 28 to 1200hrs, March 29. The Telephony section 200hrs, GMT, April 11 to 1200hrs, April 12.

ontest is divided into three sec- a) Senior Telegraphy (maximum power); (b) Junior Telegraphy tts maximum input); (c) Tele- (maximum license power).

ontest is open to British subjects Empire and mandated territories, uthorised members of the Forces e either members of the RSGB of Empire Societies (the WIA in Aus- NZART in New Zealand.)

ation is restricted to the 3.5, 7, and 28 mc/s bands.

each zone (outside the entrant's one) the first contact on a specific will count 15 points, the second 14 points and so on till after th contact they count one point This system will be repeated on band.

ll numbers must be exchanged and onsist of the RS (Telephony) or (Telegraphy) report plus three which may start with any num- tween 000 and 100 and increase by r each successive contact.

zones are numbered one to 30 and es are as follow:

e 1: AP, VU2, 4, 5, VS7.
e 2: G, GC, GD, GI, GM, GW.
e 3: DL2, MB9.
e 4: MD, MF, MT, ZB, ZC4.
e 5: VQ6, M13, ST.
e 6: VE1.
e 7: VE2.
Zone 8: VE3.
Zone 9: VE4, 5, 6.
Zone 10: VE7 and 8.
Zone 11: VK2, 3.
Zone 12: VK4, 7.
Zone 13: VK5, 6.
Zone 14: VK9, VR4.
Zone 15: VO.
Zone 16: VP1, 3, 5, 7, 9.
Zone 17: VP2, 4, 6.
Zone 18: VP8, VK1.
Zone 19: VQ1, 3, 4, 5, ZD6.
Zone 20: VQ2, ZE.
Zone 21: VQ8, 9, ZC2.
Zone 22: VR1, 2, 3, 5, 6, ZK, ZM.
Zone 23: VS1 2, 4, 5.
Zone 24: VS6.
Zone 25: VS9, VT, VU7, MP4.
Zone 26: ZD1, 2, 3, 4, 7, 8, 9.
Zone 27: ZL.
Zone 28: ZS1 2.
Zone 29: ZS5, 6.
Zone 30: ZS3, 4, 7, 8 and 9.

Also running during March is the CW section of the ARRL DX Contest. It will occupy two weekends from 2400, GMT, Friday, March 6 to 2400, GMT, Sunday, March 8, and again from 2400, GMT, Friday, March 20 to 2400, GMT, Sunday, March 22, and foreign stations will contact W and VE amateurs.

Serial numbers will be exchanged comprising RST report and three figures representing the power input; 050 for 50 watts, 100 for the limit.

Contest logs must be mailed not later than April 24, 1953, to the ARRL HQ.

The 1953 Hamfest of the NSW Division of the WIA was held on the Friday and Saturday of the Australia Day weekend. No events were conducted on the Sunday to allow amateurs to participate in the Australian National Field Day.

WIRELESS INSTITUTE ACTIVITIES

Friday evening, the normal monthly ng, a special presentation was given rence House by Stan Owen, VK2RX, ubject, The Application of Films to ision. It proved very interesting supported by films and slides, Stan ded the answers to the problems plication.

ny country members were present ding VK2OY Goulburn, VK2AXS, 2APX Dubbo, VK2TV Canberra, VK2DY Wollongong.

ring the business section of the even- Lionel Swain, VK2CS, president of Hunter branch, was elected an hon- life-member of the NSW Division, cognition of his services to amateur and the WIA in the Newcastle dis-

e Saturday session was conducted at Mackenzie's rooms, Clarence St., ey (rooms well known to thousands rvicemen during the war years).

series of lecturettes on amateur technical subjects were presented. session was officially opened by State president John Moyle, VK2JU; ral Councillor Vaughan Wilson, VW, acted as chairman.

st speaker was Bob Winch, VK20A, told of the uses of the Grid Dip llator. Producing a sample con- cted from the usual junk box pieces, hen demonstrated the GDO in action transmitter, coil, RFC's, IFF's, &c. convinced most amateurs present a GDO is a necessity.

e second lecture was presented by an Rolfs, VK2HE, who displayed and ribed his compact 50 and 144 mc/s ode converters housed in the same The RF portion of each converter prised a 12AT7 and 6J6, with a com- 6AG5 IF on 11 megs. A common dial is used for tuning on both bands with condenser shaft extended out the back to allow for mechanical tuning if required.

Lionel Swain, VK2CS, then demonstrated a complete five band single control transmitter, covering all five bands from 3.5 to 28 mc/s. The VFO is a 6AC7 Clapp oscillator driving a 6AG7 buffer. A string of 6AQ5's acted as doublers to drive the 807 final. Lionel demonstrated the transmitter showing output on the five bands by turning the band selector switch and tuning the final tank condenser to the spot required. The interesting points of design were discussed by the lecturer.

The final lecturer was Bob Black, VK2QZ, who produced from a bag all the items that radio amateurs intend to construct, to make their operating and building problems easier. They ranged from vacuum tube voltmeter, crystal calibrator, to a crystal controlled converter for the beacons on 33 mc/s.

They were all built in miniature and run from a common power supply. Those amateurs who have stripped any quantity of disposals equipment may be interested in a full height table displayed by Bob and built from IFF chassis.

Lecturers during the afternoon were competing for the President's Cup to be presented to the member who provided the most popular lecture. The winner was Lionel Swain, VK2CS, for his lecture on the five band transmitter.

The evening session was completely informal, competitions were conducted, while professional entertainers provided interesting items.

The council appreciated the assistance rendered by members especially during Saturday morning.

NORTH COAST CONVENTION.

For the fourth year amateurs on the North Coast of NSW, will run during Easter the annual WIA convention at Urunga. The two main days of the convention will be Easter Saturday and Sunday, and a very full program has been arranged.

Registration officer Allan Williams, VK2FH, will be on duty at the "Do-me" shack on the Saturday morning. General assembly will be at the same venue at 2 pm, and the contest for the G. Challender Memorial Trophy will be conducted from 3.30 to 5.30 pm on the 40 metre band.

Saturday evening will be devoted to general entertainment for all attending.

The program on Sunday features two 144 mc searches, one at 10 am for the Gleeson Bros. Trophy, a silver cup. The winner will receive a silver teapot and a replica of the cup. The second search will commence at 11.30 am and is for the Fred Leader Trophy, first prize a household article at £7. The transmitters will be hidden within five miles of Urunga. Competitors before starting must register their receiver and obtain an official number. Car transport is available, and the searches will commence from the hotel green.

At 2 pm everyone is requested to assemble on the green for photos and moxies, and a trip to Bellingen to see VK2QV's quads (not forgetting Mrs. Sara).

From 3 to 4 pm the Urunga Scramble will be conducted for the United Radio Distributors, Sydney, Trophy. A replica of the trophy and open orders will be presented to place-getters. Any equipment, any band, and any power, may be used, the station contacting the most stations in the prescribed period winning the event.

During the Sunday evening an official welcome will be given by the Shire President, and the local Progress Association. The prizes won in competition will be presented and a musical and film evening will then be conducted.

Monday, April 6, will see the conclusion of the event when there will be a general get-together and farewell.

Applications for accommodation should be made direct to Mr. Theo Cummings, Ocean View Hotel, Urunga. With hotel bookings a deposit of £1/10/- per person should be forwarded with the application. Shack accommodation is available and application should be made also to Mr. Cummings — bring your own blankets.

The following committee is responsible for the organising of this year's North Coast Convention, and any of the members will be pleased to supply further information.

President Crieff Retallick, VK2XO, Organiser Rod Pike, VK2ACU, Registration and Log Returns Allan Williams, VK2FH, Emission Tester Peter Alexander, VK2PA, General Noel Hanson, VK2AHH, and Percy Sara, VK2QV, Publicity, Allan Williams, VK2FH, and Chick Wilkins, VK2ALB, and Ladies' Organiser Jean Dan, Mrs. 2ABU.

North Coast conventions have always provided those attending with a weekend of excellent entertainment—you are assured of a good time—so book as soon as possible.

★ ★ ★

The AOCP classes of the NSW Division are now held at new rooms. The new address is: Room 601, 6th floor, Railway Institute, Castlereagh St., Sydney. Inquiries however, should still be adddessed to the Class Manager, Box 1734, GPO, Sydney.

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0-900 r.p.m. 6in dial, ⅜in inside diameter on coupling. Made by Synchrotac of Melbourne. Price £7/10/-.

Postage and Packing: Vic., 6/-; NSW, SA, Tas., 8/6; Qld., WA, 11/-.

INSTAL YOUR OWN BURGLAR ALARM

by fitting Micro Switches. Micro Switches are compact precision snap switches, small and easily concealed. The slightest movement of door, window will bring the switch into operation.

These Micro Switches are easily installed, and a circuit diagram is supplied free.

They can also be adapted for many other useful purposes where a precision snap switch is required.

CLEARANCE PRICE: Three for **22/6**

Post Free.

USEFUL KITS OF PARTS FOR HOME CONSTRUCTORS

No. 1 CONTAINS

2 Key Switches
2 Co-ax Connectors
1 reel Dial Cord.
1 2 mf Condenser
1 .5 mf Condenser
1 4 mf Condenser
4 Shock Mounts

22/6 POST FREE

No. 2 CONTAINS

2 ½ meg 1 watt IRC Resistors
2 1 meg 1 watt IRC Resistors
3 1204 RF Pentode 6 volt Valves and Sockets
1 Telephone Jack, DC closed circuit
1 Bakelite Toggle Switch
1 single Bank Rotary Switch, 5 position.

22/6 POST FREE

No. 3 CONTAINS

6 Terminals
1 Telephone Jack
2 Co-ax Connectors
1 reel Dial Cord
4 Shock Mounts
2 ½ meg Resistors
2 1 meg Resistors
1 Bakelite Toggle Switch
1 Single Bank Rotary Switch
1 Key Switch

22/6 Post Free

TRANSMITTER & RECEIVING SETS TYPE AT.5/AR.8

The transmitter consists essentially of two separate sets of tuning circuits, M/F covering from 150-500 K/cs, and HF covering from 2-20 M/cs. The same valves are used on both ranges and the change of LC circuits, etc., from M/F to H/F is effected by a single switch. Thus one pre-set M/F and one pre-set H/F is available at all times.

Valves—Commercial types are used as indicated:

H/F Oscillator	6V6G
H/F Buffer-Double Amplifier-M/F Oscillator	807
Power Amplifiers	2-807
Modulators	6V6G

Receiver £25/0/0. Transmitter £12/10/-.

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12v 500w brand new £7/10/-
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24v 1000 watt brand new Bendix fitted with 3½in Double Vee Pulley . . . £19/15/-
24v models can be used as 32v without alteration.
100v 600w £15
50-0-50 Ammeter, moving coil £2/10/-

Postage and Packing on Ammeter: Vic., 3/6; NSW, SA, Tas., 4/-; Qld., WA, 4/6.

3½in V Pully to suit 12 and 24v models . . . 35/-
Postage and Packing: Vic., 3/6; NSW, SA, Tas., 4/-; Qld., WA, 4/6.
12v Cut-out . . . 15/-
Postage and Packing: Vic., 3/6; NSW, SA, Tas., 4/-; Qld., WA, 4/6.

Regulator & Cut-out

Suitable for use with 24v and 32v Generators, or as tractor spare. Made by Bendix of U.S.A. Price £3/10/-.

Postage and Packing: Vic., 5/-; NSW, SA, Tas., 7/-; Qld., WA, 8/6.

LEAD ACID ACCUMULATORS

Type B. 2 volt 20 amp hours. Made by Exide. Size 7in x 3½in x 2½in. Weight 3½lbs.

3 for 30/-

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Magnetic type, high output. Can also be used as contact microphones on musical instruments. Comprises two microphone units which may be used separately. **12/6**

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19 Volt MOTORS

Laminated field for use with AC or DC supply. Approx. 1/10 H.P. Good general purpose motor for low voltage systems.

£1/19/6

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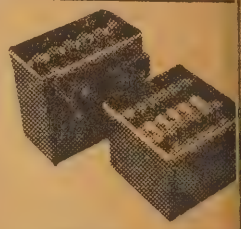

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2-955	1-6H6	1-5V4

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BRAND NEW

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Type CPR-55 ABB Containing 5BPI CR Val and full-length Mu-Met Shield, 3—6H6 and 4—6AC7.

BRAND NEW

£12-10-0

r at the February meeting of
orian Division was Harry Kin-
3KN, who told of his experi-
his recent overseas trip. He
television in both England and
nd many other interesting fea-
he lecture was recorded and the
is available to members inter-

decided at the Federal Con-
of the WIA held in Sydney, that
nventions would only be held
vo years. It has been decided
majority of divisions that a con-
would be desirable this year and
uled to take place in Melbourne
Easter.
cently elected Federal Councillor
Victorian Division is Fred Bail.

CTIVITIES

late January and early Febru-
emely good conditions were ex-
d for extended ground-wave
on both the 50 and 144 mc/s

May, VK2PM, operating from Can-
n 144 mc/s has added some inter-
1 has contacted most Sydney
over the 150-mile path. Arch
K2GU, has also been active and
hanged S9 signals both ways on

Webster, VK2EW, operating port-
th only 6 watts on 144 mc/s has
ed both VK2PM (150 miles) and
(180 miles) Wally used a three
ree beam.
VHF group of the Victorian Divi-
nducted a Field Day on 50 and
s on February 1. Stations through-
State were active on both bands.
h Northern Tasmanian stations
ctive propagation conditions were
table for interstate contacts.
further field days will be con-
during the season, the dates are
15 and April 26.

REGULATIONS

regulations listed at the Atlantic
adio Conference in 1947 a new
of figure and letter groups to
y the various types of emissions.
e designations consist of either two
e symbols according to the follow-
aracteristics. 1. Type of modulation.
e of transmission. 3 Supplementary
teristics.
three groups are subdivided as
s:—
es of modulation: 1. Amplitude
l "A," 2. Frequency or Phase "F,"
"P."
es of transmission: 1. Absence of
odulation intended to carry inform-
"O." 2. Telegraphy without the use
odulating audio frequency "I," 3.
aphy by the keying of a modulating
frequency or by the keying of the
ated emission "2." 4. Telephony
. Facsimile "4," 6. Television "5,"
nposite transmissions and cases not
ed by the above "9."
plementary characteristics: 1 Double
nd full carrier — no symbol, 2.
side band reduced carrier "a," 3.
ndependent sidebands reduced car-
b," 4. Other emissions reduced car-
'c," 5. Pulse amplitude modulated
6. Pulse, width modulated "e," 7.
phase (or position) modulated "f."
an exception to the above principles
ed waves are designated by "B."
following are some examples in the
f the above code.
—normal CW transmission.
— Amplitude modulated telephony.
— Amplitude modulated telephony,
sideband, reduced carrier trans-
on.
— Frequency modulated telephony.

DX and PERSONAL

ing most of January 14 Mc provided
excellent DX around 2400 hrs EAST.
band was particularly good to the
le East. Some QTH's are as follows.—
AK 14.030 kc's — Box 35 Damaseus
EA9AX 14.100 kc/s — Box 313
la, Spanish Morroco. Rafall EA9AX
uses 10 watts to a dipole.
3CB, 14,040 kc/s 2050 hrs registered
minute CQ call in January. After a
econd listening period he was off,
, leaving a few disappointed VK's
is an added prefix to the normal
prefix for West German nationals —
a number of stations using the new
x are heard.

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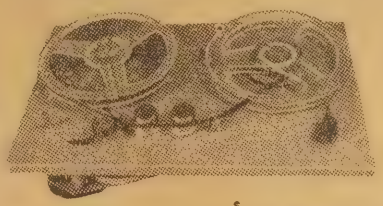
Assembled and tested with two heads. (Supersonic erase) £29/0/0



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Type 52 R/P Half Track Record-Playback Heads.
Type 52 E Half Track Erase Head (Supersonic).
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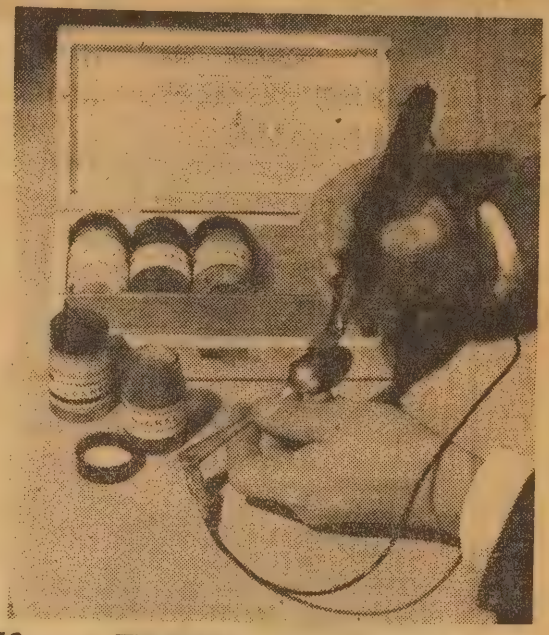

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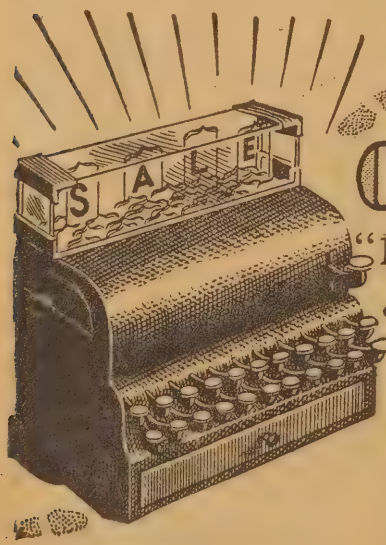

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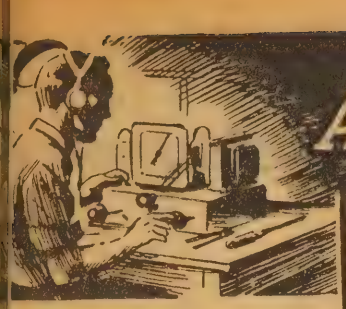
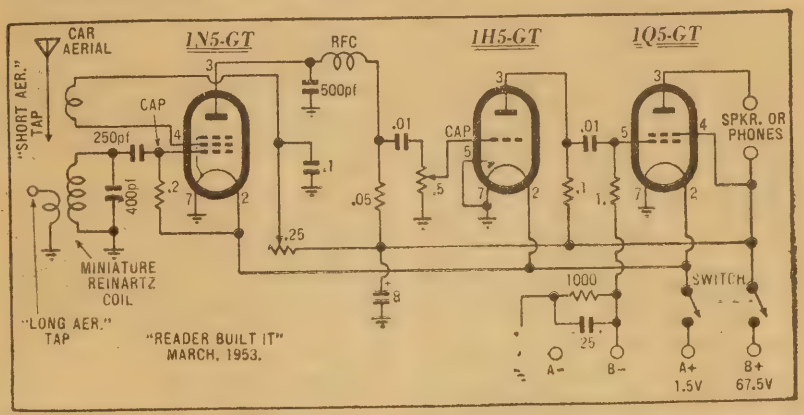


A READER BUILT IT!

Gadgets and circuits which we have not actually tried out, but published for the general interest of beginners and experimenters.

THREE-VALVE PORTABLE USES CAR AERIAL

: are details of a portable which should have some rimental interest to those want to put to some use e odd "bits and pieces" lly found around a radio hobbyist's workshop.



contributor, Mr. B. Ibbotson, lare, Girraween Grove. Bris- Queensland, is keen about the nance of this set and finds it satisfactory in the role for it was intended.

s constructed in a mine de- case purchased from Dis- sources rather cheaply. Al- the "GT" valve types are here is sufficient space for the alternative 2-volt

From what we can gather from the letter, a s comes with the case. A canvas carrying bag supplied, which enables the unit to be carried e's back, haversack style.

ccording to our contributor, the only modification case is to remove one of the rivets holding the nd with the aid of a drill and a rat-tail file e the hole to take a rubber grommet of about inside diameter.

A telescopic car aerial is passed through this grommet, and it is suggested that the grommet be glued in place to avoid its being pushed inwards when the aerial base rod is fitted in.

One of the mounts for the base of the aerial is made up from a disposals headphone jack by enlarging the diameter of one of the holes to take the aerial rod. A hole is drilled and tapped in this base mount to hold the aerial firmly in position. Alternatively, you may be able to make the rod a force fit in the headphone block mounting or let it pass through the block and fit a small dog clip to prevent it from pulling out when extending the telescopic lengths.

The upper aerial base mount is fashioned from a block of hard rubber or similar form of insulation, and held in position by a suitable bracket. Depending upon the form of construction you adopt for the lower mounting, you may be able to dispense with the upper mounting, allowing the rubber grommet to provide the appropriate support.

THE CIRCUIT DESIGN

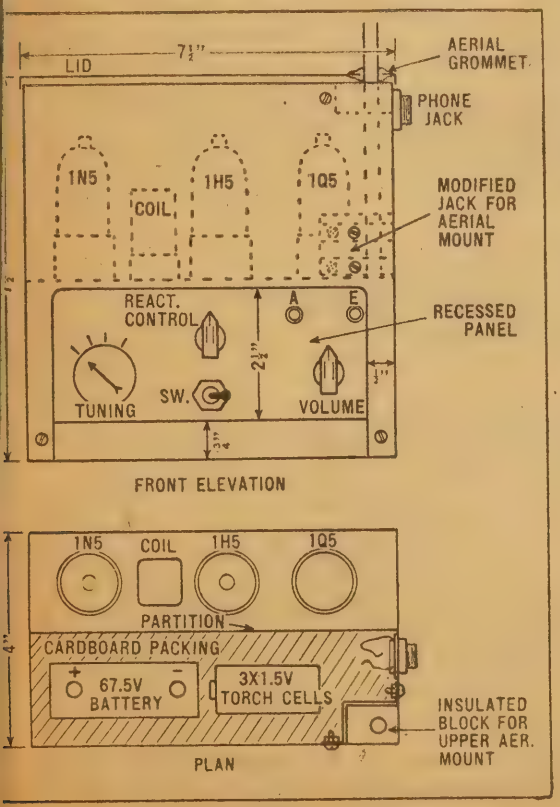
The circuit itself is quite straightforward and should present no difficulties. The 1N5GT is a simple regenerative detector employing a miniature commercial Reinartz coil. A 1P5GT could be used here without any change in circuit. Note that the telescopic aerial should be connected to the "short aerial" terminal.

The output from this detector is fed to a volume control from which an appropriate level may be fed to the 1H5GT triode for voltage amplification. The coupling capacitor to the volume control may be any value from .01 mfd to about .05 mfd. This also applies to the coupling capacitor to the grid of the IQ5GT.

The diode anode of the 1H5GT is not used and is connected to the negative side of the filament. A pentode valve may be used here by tying the screen to the anode. Such a valve wired as a pentode would increase the voltage gain of the stage, but may call for some care in layout to avoid possible instability. A point here is that you may need to mount the aerial on the other side of the case near the 1N5GT to avoid coupling between it and the audio output stage wiring.

It appears that our contributor uses phones with this set as there does not seem to be any provision for the mounting of a small speaker. You may, however, find that this is possible with your particular case.

Mr. Ibbotson suggests that the set works well with headphones even with only 35 volts of HT. He suggests that experimenters can economise by using discarded batteries from a local radio store.



MAKE THIS WOOL-WINDING MACHIN

The simple machine shown in Fig. 1, is for winding wool as purchased in hanks into a suitable form for knitting. This is a necessary task disliked by all home knitters as it is such a lengthy operation.

BY W. BROOK

THE advantages of this machine after a trial for a period of a few months are:—

(1) Winding time cut by 80 pc.

(2) Much easier to wind, only necessary to turn the handle after setting up.

(3) No possibility of stretching the wool as all tension is released when removed from the machine.

(4) For delicate shades the complete package can be wrapped in soft paper after winding and the wool withdrawn from the centre thus ensuring cleanliness during knitting.

(5) As the package remains stationary all the time wool is withdrawn there is no danger of it rolling about and getting into a tangle, as is often the case when wound on to a ball.

The essentials are to gear the winding spindle up from the turning handle and down for the traverse mechanism. Any means can be adopted for this as the ratios are not critical, but the aim is to have as large a ratio between hand wheel and spindle as possible for speed of operation.

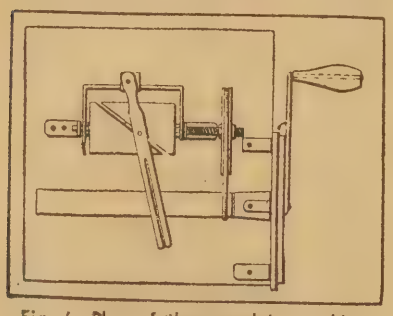


Fig. 6. Plan of the complete machine.

The basis of my machine centred around a hand grinder, obtainable at most cheap stores. This is ideal for the purpose, the rest of the parts being found in the junk box.

The spindle consists of a length of copper tube 6in x ½in, with a piece of brass 1in long and a tight fit into the copper tube. Solder this in one end, and bore a hole down the centre of this brass 2BA tapping size.

Follow this hole with a 2BA clearance drill for half the length of the brass and run a 2BA tap through the remaining ½in. This spindle will now screw on to the spindle where the emery wheel was removed on the grinder. (Fig. I will make this clear.)

The brackets for the traverser are made from brass valance rail, bent and secured as shown in Fig. 2. Another piece of valance rail is cut and bent to hold the traverser itself (Fig. 3). A piece of rail is bent at right-angles, bored and tapped 2BA and soldered as shown.

The cam is made from a 2in length of tube, 1in diameter. Starting at ¼in from one end saw the tube in two, to ¼in from the other end, that is a diagonal cut through the tube. The edges must now be made perfectly smooth and free from sharp edges. &c. (Fig. 4.).

Two discs are now made to fit tight into the round ends one in each of the two halves of the cam and soldered in position. In the centre of each of the discs a 2BA clearance hole is drilled.

A distance piece is made from a piece of tube, the bore being large enough for a length of 2BA rod to go through, having an outside diameter of not more than ½in. The length of this tube is adjusted so that when inserted between the two halves of the cam there is a gap of 1-8in all round.

ASSEMBLY DETAILS

A 5in length of 2BA screwed rod inserted through the two halves of the cam with the distance piece between. A nut at each side will hold the whole together.

I found that an old toothbrush handle, about 6in long, was ideal for the wool traverse guide. At one end a 2BA clearance hole is bored, the other end having a 1-8in slot cut down the centre for a distance of 4in. It will be found that if two blades be placed together into an ordinary hacksaw frame, the desired width of cut will be obtained. This cut must now be made perfectly smooth with sand-paper.

At a position 1½in from the hole in this guide a 1-16in hole is drilled and a panel pin of a suitable thickness to be a tight fit is inserted.

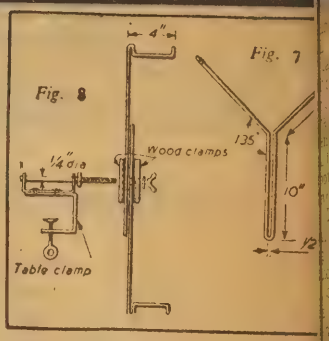


Fig. 7, 8. Details of the con swift and table clamp.

This is best done by warmi guide over a gas flame, thus sof the material so that the pin m easily forced in. On cooling i be found that the pin is held firmly. The pin is now cut off ing ½in protruding at one side 5).

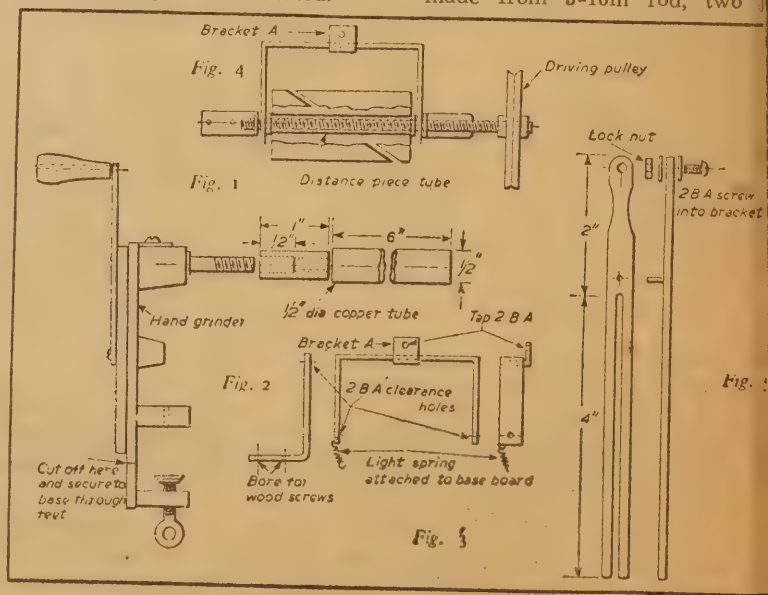
A pulley is now made fron suitable material; the diameter critical, but should be as lar possible. This pulley has a hole bored and tapped 2BA a grooved around the circumfe for a round belt. All these part now be assembled, as in Fig. 4.

The driving belt for the tra from the driving spindle is from a piece of spring curtain just long enough to have a tension.

The last turn on each end is in line with the spring and hc into each other.

For the baseboard a piece of ¾in x 6in x 6in approximately used, planed and polished if re ed, on which all the parts may be assembled, as in Fig. 6, to plete the machine.

The swift for holding the ha made from 3-16in rod, two



Figs. 1 to 5. Details of the operating handle, traverser and brackets.

uired exactly alike and bent in Fig. 7.
ieces of hard wood are cut x 1in, a ¼in clearance hole illed in the centre of each grooves cut down their see Fig. 8). These grooves old the 3-16in rod in position mped by a wing nut.
l be apparent that any size can be used by loosening the and adjusting the two hold-out.
ank swift is attached to a nt chair or table and ad- hold the hank of wool firm-ot too tight, noting that the volves evenly and not out of It is an advantage to open l out to ensure that during the wool has not to pull derneath the layers.
break the knot joining start to the finishing end. Take hese ends, for preference the ing from the top of the swift, ead it through the guide on chine, leaving a few inches off the end of the winding

a few turns around the spin-h the end coming from the order to give the spindle a

turn the handle and see that ol is being withdrawn from ift and that the traverse is g back and forth. Continue to the end of the hank. It is antage to have as great a dis-as possible between the hank e winder.
n all the wool is wound on ndle a piece of paper may, if ry, be wrapped around the nd secured with a rubber band. emove wool from spindle place r at each side of the spindle g end) and pull off. When the ge" is pulled off, the centre llapse, thus relieving any un-sion which may have been put cing winding.

HOW TO USE OUR OSCILLATOR

(Continued from Page 81)

hole of the audio circuit, is in-nd that the fault lies in the ion of the aerial. From the grid IF valve signals should be very stronger and any failure at oint would throw suspicion on alve or its operating voltages.
ch the same results should be ied from the plate of the con- valve and a failure would bly indicate a faulty IF trans-r. Moving to the grid of the rter should produce a slight in-e in gain and it should be pos-to obtain output from both the c and 600 Kc signals, the latter ring that the gang be correctly Failure to pass the 600 Kc signal d indicate a fault in the local ator circuit.
ally, it should be possible to n a 600 Kc signal from the aerial inal and, although a failure at point is not common, it could aused by a shorted trimmer, a y aerial coil, the aerial terminal ed to chassis, or a similar fault. us it is possible to test the whole e front end of the set, stage by , until the faulty section is loc- Once this point has been estab-d it is relatively easy to concen- on it to determine the exact e of the failure.

TRANSISTORS ARE NOT READY YET

(Continued from Page 9)

Transistors have been immersed in water for several months, with practically no effect.

Although high ambient temperature is now a limitation, developments indicate progress in lowering this barrier. No damage occurs to the transistor during storage from minus 94 degrees F to 212 degrees F. Operation over the wide ambient range of minus 94 degrees F to 122 degrees F is practical and higher ambient temperatures will be feasible if proper attention is given to heat dissipaton.

Uniformity of characteristics comparable to that of the electron tube seems possible. The art of crystal growing is rapidly progressing and the uniformity of germanium has progressed to the point where various transistor characteristics such as current amplification, power gain, feedback resistance, and input and output resistance have been controlled within plus or minus 25 pc.

At present, the characteristics of high gain, low noise, greater stability, higher efficiency and higher power capabilities indicate that the junction transistors will be used principally as oscillators and amplifiers at lower frequencies. Another feature of the junction transistor is its ability to oscillate with power inputs around one-millionth of a watt.

On the other hand, the point-contact transistor may be applied to very-high-frequency circuits wherever noise is not a limiting factor. Another feature of the point-contact transistor is the negative resistance properties which are especially useful in counter and similar circuits.

Estimates of the time when transistors will be available in quantity for production of saleable products must be somewhat speculative.

Engineering of some types of transistors has reached an advanced stage. The problem of providing adequate supplies of processed germanium with proper characteristics at reasonable costs remains to be worked out.

Limited application in special devices where cost and quantity are not major factors is close at hand.

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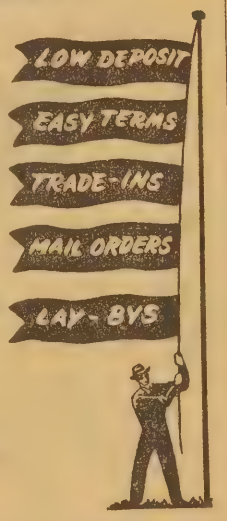

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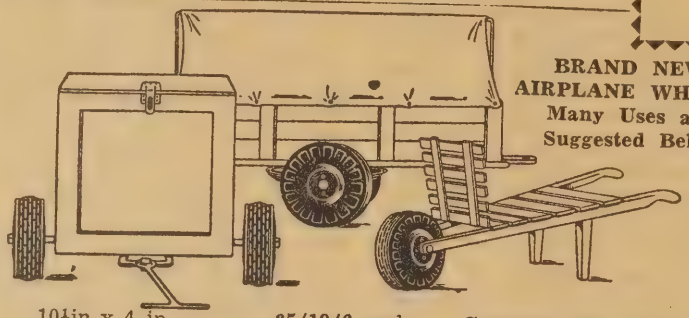

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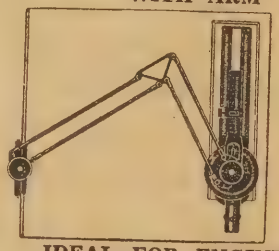

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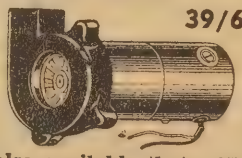

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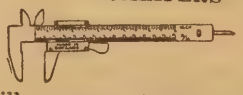

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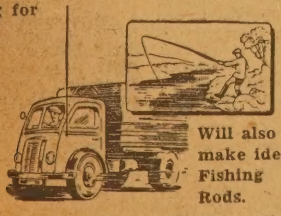
EEL ARMY TANK AERIAL DS WILL MAKE IDEAL DIO AERIALS FOR CAR OR TRUCKS.

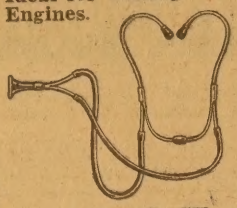
ong for ge, e st ay n.



to l, d. Will also make ideal Fishing Rods.

long, 3 sections. Each section 22/6. 8ft. long, 2 section, 15/-.

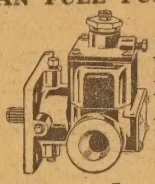
MECHANICS' STETHOSCOPES.
Ideal for Testing Engines.



35/- EACH

AMERICAN FUEL PUMPS

USED BY THE R.A.F.
STAINLESS STEEL VANES

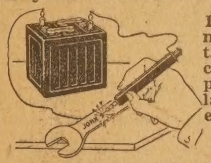


WILL PUMP ANY LIQUID

400 galls. per hour. In excellent order, 55/-. Brand new, 75/-.

ELECTRIC ENGRAVER

What everybody has been waiting for. An Electric Engraver that works off your car battery.

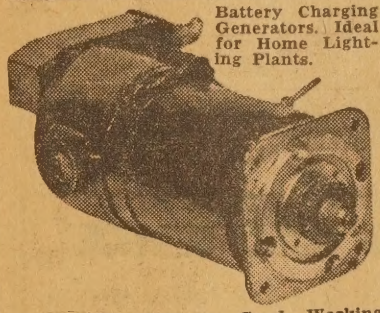


Engraves anything in metal.

Ideal for name tags, dog collars, plant labels, etc.

29/6

Engrave your name on all your tools. Marked tools are never stolen. No Garage should be without one.



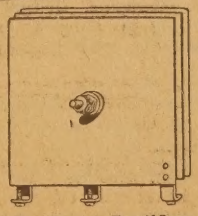
Battery Charging Generators. Ideal for Home Lighting Plants.

12-volt 500 watt, in Good Working Order £5
12-volt, 500-watt, as new £10/10/-
24-volt, 1000-watt. Brand New, £12/10/-

BRAND NEW ENGLISH RECTIFIERS

Make yourself a Battery Charger.

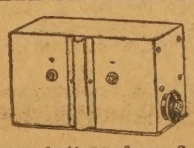
12v. 2 amp, 35/-
6v. 5 amp, 50/-
12v. 5 amp, 79/6
6v. 2 amp, 24/6
12v. 3 amp, 45/-
6v. 4 amp, 45/-



Transformers to suit above Rectifiers, 2 amp, 37/6. 6 volt 5 amp, 45/-. 12 volt 5 amp, 57/6.

COMPLETE BATTERY CHARGER

Fitted with brand new English Selenium Rectifier.



Works off 230v. AC Household Supply.

Charges any battery from 2 to 6 volts at 4 amps. £6/15/-, complete.

SPECIAL DISPOSALS METER OFFER

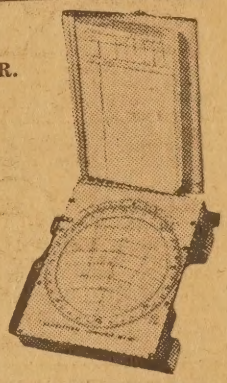
0-1 milliamp, 2½in dial 37/6
English 0-40 voltmeters 2½in Dial M/coil 25/-
Weston 0-50 volt 0-100 amps combined M/coil, £3/10/-
English 50-0-50 Ammeters M/coil 37/6
English 20-0-20 Ammeters M/coil 37/6
English 0-20 Voltmeters M/coil 25/-
English 0-300 AC-DC Voltmeters 55/-
English 0-5 Milliammeters, 2½in. 27/6
English 0-150 Milliammeters, 2½in. 30/-
English 0-10 Ammeters, 2½in Dial 30/-
English 0-10 Ammeters, 2½in Dial Moving Coil 45/-
English 0-30 Voltmeters, 2½in Dial AC-DC 42/-
Eng. 0-40 Ammeters, 2½ Dial AC-DC 42/-
English 0-50 Ammeters, AC-DC 42/-
Eng. 0-3 Ammeters 2½in Dial AC-DC 45/-
Eng. 0-5 Ammeters 2½in Dial AC-DC 45/-
Eng. 0-150 Voltmeter, 3in Dial, Moving Coil 39/6
Eng. 0-500 Micro Ammeter M/coil 37/6
Eng. 0-150 Ammeters, 3½in Dial, AC-DC 84/-
Eng. 0-50 volts 3½in Dial, AC-DC .. 75/-

IN FIRST-CLASS ORDER.

DALTON COMPUTORS IDEAL FOR AERO CLUB, A.T.C., ETC.

Only Limited Stocks Available. Be early.

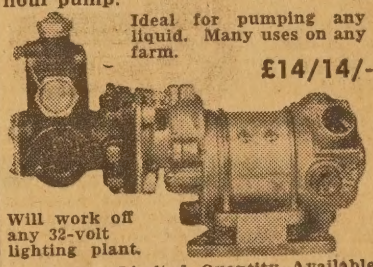
45/-



Lucky Repurchase! Aircraft 24 volt motor complete with 400 gal. per hour pump.

Ideal for pumping any liquid. Many uses on any farm.

£14/14/-



Will work off any 32-volt lighting plant.

Be Early. Limited Quantity Available.

IDEAL FOR ENGINEERS, STUDENTS, ETC.
BRAND NEW AIR COMPRESSOR
2.2 cubic feet, will pump up to 75lb.

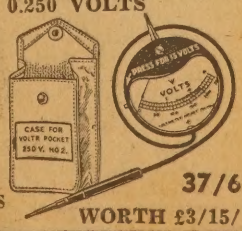
Never before at this price. Ideal for Spraying.

£11/15/-

Will work off ¼hp Motor.

AT LAST! British Army Issue DOUBLE SCALE VOLTMETER 0.15 0.250 VOLTS

IDEAL FOR BATTERY SET USERS AND DEAF AID USERS OR HOBBYISTS



37/6

WORTH £3/15/

ANSWERS TO CORRESPONDENT

B.M. (Parkes, NSW) writes to comment on Radio and Hobbies and to tell us of some of his experiences with amplifiers, including the Williamson. He also inquires about the VR65A and the 6SH7.

A. Yes, B.M., it needs a lot of high quality equipment to show the Williamson, or any other good amplifier, to its best advantage. The circuit you suggest is not a new idea and has been suggested in slightly different forms on previous occasions. One disadvantage with the system as it is shown is that the load on the crystal pickup will vary with the setting of the volume control, thus varying the bass response. The VR65A is the service version of the British Mazda SP41. This is a 4-volt filament version (the VR65 is a 6-volt version) RF pentode with a sharp cut off characteristic. It may be operated with up to 250 volts on plate and screen and requires 2.5 volts negative bias. The mutual conductance is 8.4 mA/V. Pin connections are as follows: 1 and 8, filament, 2 cathode, 3 plate, 4 screen, 5 suppressor, 6 shield, 7 blank. Top cap grid. The 6SH7 is similar electrically to the 6AU6 but cannot be used as a remote cut-off valve. Your letter has been passed on to the Serviceman for possible comment at a later date.

R.M. (Armidale, NSW) wants to build the wide band tuner and is anxious to know whether he can use a 6U7 as the intermediate amplifier. He also inquires whether a 385-volt transformer can be used with the 10-watt Playmaster amplifier, assuming the addition of a series resistor in the HT line.

A. Providing standard type IF transformers are used it should be possible to bring the grid lead out the top of the can and there should only be a small length unshielded and it is not likely that you will strike trouble with instability. However, the lower gain of this valve may prove a disadvantage, particularly in your location, and we suggest that the original type be used for this reason. There should be no objection to the use of the transformer you suggest, the additional resistance, while perhaps theoretically undesirable, being unlikely to cause a serious reduction in power output. This is particularly so if the equipment is intended mainly for domestic use and at the usually moderate power levels required.

J. T. J. (Scone, N.S.W.) sends a circuit of a small two valve battery operated amplifier. He wonders if it would be of any value to us for the "Reader Built It" page.

A. There isn't anything unusual about the circuit to make it of special interest J.T.J., but we will keep it on hand for possible use at a later date. Glad to know that you have had such good results with "Tex" and "Little Jim."

D.A.A. (Wellington, NZ) has been looking through a valve manufacturer's handbook and has found a number of valves that he thinks would be suitable for the "Playmaster" amplifiers.

A. As you say, possibly the valves could be used in the "Playmasters" but we would not like to comment further until we had had a chance to go into the matter in more detail.

C.C.D. (Cumberland Park, SA) has built the New 5" CRO but is having trouble with hum pickup &c. in the tube.

A. It is almost certain that you will need to shield the tube with a mu-metal shield, a point which we made in the original article. In our case we obtained one from disposals equipment, but you could probably also obtain one from some of our advertisers who supply kits for this equipment. Alternatively, we understand that AWA Telcon, 47 York St., Sydney, handle this material and may be able to supply the shield that you require. The small dark patches in the trace are most likely due to radiation from the time base being coupled into the intensity grid. It may be necessary to modify the wiring somewhat to overcome this problem.

C.H.S. (Chatswood, NSW) wants to buy a circuit of a six valve portable set or details of how an extra valve can be added to an existing five-valve set.

A. We have no circuits of such a set, C.H.S., nor would it be very feasible to add an extra valve to an existing set. Even if it could be done there is considerable doubt whether the improvement would be noticeable. Increased range is not simply a matter of increasing the sensitivity of the set, even assuming that this can be done conveniently, because no increase in sensitivity will make a signal audible if it is already masked by atmospheric noise. Thus there is an optimum degree of sensitivity beyond which there is normally little to be gained. It is generally considered that this order of gain should be possible with of set you have (assuming it is correctly) and about the only ments possible in difficult situ the use of an efficient aerial. sets consistently give better perf than yours it would suggest that is not working as it should and be advisable to have its perf checked.

R.L.K. (Eaglemont, Vic.) want advise him of the cost of mak Electronic Flash unit featured August, 1952, issue.

A. Sorry, R.L.K., but, as we have out many times in these columns, prices is not part of our job. only advise you to contact our adv who specialise in such parts and a far better position to help yo we are.

C.H. (North Cottesloe, WA) fo us 12 months' subscription for Rad Hobbies and also an amplifier circu the request that we comment latter.

A. Thanks for the subscription and we have forwarded this to t propriate department. Without full ledge of the types of pickup to b we cannot comment fully, but it appear that they are of the low magnetic type and, quite probably, out any bass boost characteristic. is so the amplifier will certainly to include a bass boost circuit alo lines of the Playmaster Control otherwise the reproduction will woefully thin. The method of mix quite a conventional one, though i not provide separate control for pickup which would sometimes b sirable. The remainder of the appears fairly conventional.

V.H. (North Geelong, Vic.) in whether we have at any time pub data on household mixers, with part reference to the method of speed co

A. No, V.H., we have never pub anything along these lines and w afraid we cannot help you very It is doubtful whether anything alon lines of an induction disc motor for g phones would be suitable since the requirements are quite different.

G.S. (Baradine, NSW) inquires wh we have any circuits for a four or valve broadcast receiver for oper from dry batteries or vibrator.

A. We have several circuits on our which would probably suit you and suggest the Pentagrid Five (Decem 1950), the Pentagrid Four (Septem 1950), or the Vibra-Five (December, as possible designs. Circuits, &c., be obtained through our postal se at the rate of three complete sets 2/-. (See details this page.)

W.A.B. (Kelvin Grove, Q) makes s inquiries about some of the charger cuits published recently.

A. The rectifier LT53 is a copper o type W.A.B., while the connections the smaller rectifiers should be as sh in the original diagram for the Tri Charger, that is, the centre contac negative, the two outside contacts gether are positive, and the remai two AC. Most transformers are desig on the basis of a certain number circular mils wire cross sectional per amp, though the actual number va from one authority to another. The AR Handbook quotes 1500, but this appe to be a conservative figure and we und stand that many transformer manuf turers work on about half this figure w complete success, while another autho quotes 450 to 800 as being suitable val The area in circular mils can be asc tained from any wire table.

J.M. (Gisborne, NZ) suggests that publish some details of low powered, battery operated, amateur equipment use on 80 metres.

A. Thanks for the suggestion, J.M., we will keep the idea in mind. Howev there is some doubt whether operat would be very economical, particula with regard to the transmitter, a modern dry accumulators appear to of many advantages where portable equ ment is concerned.

THE "RADIO & HOBBIES" QUERY SERVICE

ALL queries concerning "R & H," designs, to which a POSTAL REPLY is required must be accompanied by a postal note or stamps to the value of TWO SHILLINGS.

For the same fee, we will give advice by mail on radio matters, provided the information can be drawn from general knowledge. UNDER NO CIRCUMSTANCES, however, can we undertake to answer problems involving special research, modification to commercial equipment or the preparation of special circuits.

Whatever the subject matter, we must work on the principle that a letter is too involved if the reply takes more than 10 minutes of our time.

Queries not accompanied by the necessary fee will be answered FREE in the columns of the magazine and presented in such a way as to be of interest to other readers.

To those requiring only circuit reprints, &c., we will supply for TWO SHILLINGS diagrams and parts lists from our files covering up to three "R & H" constructional projects. Scale blueprints showing the position of all holes and cutouts in standard chassis will now be 4/6. These are available for nearly all our designs but please note they do NOT show wiring details.

Address your letters to The Technical Editor, "RADIO and HOBBIES," Box 2728C, GPO, Sydney.

Note that "RADIO & HOBBIES" does not deal in radio components. Price quotations and details of merchandise must be obtained direct from our advertisers.

undabera, Q) writes to tell the
about two cases of faulty
s which had the same symptoms
ame defect, a faulty barretter

thanks for your letter, P.H., and
passed it on the serviceman for
le comment at a later date. In
ime it is interesting to hear of
ase, which would suggest that
ous ones were not isolated in-
id that there may be a funda-
eakness in the design. We sug-
it may help future production of
s if the makers were acquainted
facts. Many thanks for your
arks about the magazine and we
to hear that you find so much
ormation in it.

(Nundah, Q) sends a letter for
n expressing his appreciation of
les and suggesting that they
ntain some advice on the use of
oment by the beginner. He also
a simple tip for storing and
ing miniature valves.
have passed your letter on to
ceman for his possible comment
r date, D.W.N., and we suggest
the meantime, you study the
ways in which the use of test
nt is described in the articles,
idea of learning as much as pos-
the way in which each piece is
l.

(Warialda, NSW) wants to know
e can secure a 32-volt receiver
ses the 32-volt supply only as the

described such a receiver in
d Hobbies for January, 1950, while
or version, using standard HT
was described in October, 1950.
diagrams, &c., for these sets are
through our postal service.
ails on this page.)

(Paddington, Q) wants to build
quality radiogram and would like
ggest a suitable design.
thout some details of the type of
ance, both on radio and records,
ou require, J.R.H., or the amount
ey you are prepared to spend, it
r difficult to advise you. One of
st designs is the Wide Band Six
r, 1952) while other designs, such
1950 Radiogram (January, 1950)
1951 Majestic (August, 1951) may
erest you. Circuits, &c., for all
ts are available through the postal
(See details this page.)

(Middle Brighton, Vic.) is anxious
the "All Band TRF" in a boat,
had good results from it when
d from AC, and wants to know
r there is available a power supply
ate it from six volts.
e have no power supply designed
ly for this set, but it should be
to operate it from a conventional
r supply such as that described in
vember, 1948, issue. The slightly
voltage would not be a serious
on or, alternatively, a transformer
ilar rating to the original could
ly be obtained to special order. We
point out, however, that it is likely
will be somewhat less pick up in
than is usually obtained when
ng from the mains, due to the latter
as a fairly efficient aerial.

t. (Strathfield, NSW) has a set
fades suddenly and which can be
d by switching off and on again.
also having trouble with the two
short-wave set described in the
Wave Handbook.
The fading trouble with your set
an uncommon one, though it can
cy difficult to track down. It is
caused by a defective connection
often remains intact for long
s and then becomes intermittent.
quent offender is a paper capacitor
almost any other component could
e trouble. It is impossible for us
exactly what it may be and we
t that you enlist the aid of a com-
serviceman. There is some doubt
the phone connections to your
wave set, but we take it that the
ng only occurs when the phones
ot connected to the set. If so this
te normal and is due to the very
voltages being developed across the
t infinitely high plate load presented
speaker transformer with an open
dary. The fact that the set oscillates
te normal and, in fact, it would not
rking correctly if it did not. How-
it is important that this condition

SUGGESTION FROM INDIA:-

Dear Sir,

I would like to put forward a suggestion which may fill in a page or two of your excellent paper should you ever become "stuck" for a comparatively new topic.

As you probably know Europeans in India are required to make practically sole use of the short-wave bands for their radio entertainment and, of course, also Indians who prefer Western music and programs to those in the various regional languages. For this type of listening many British and European firms manufacture receivers with bandspread ranges for the different short-wave bands, some are very effective and give good results and I feel your magazine will satisfy a popular, even if small, demand for a bandspread SW receiver, if you ever decided to publish one.

Of course, there is, no doubt, quite a big section of radio fans in Australia who would be interested in such a set.

Incidentally, should my opinions be of any use, I have never yet seen an Australian manufactured radio set up for sale in the radio trade in South India. Would it not be worthwhile for Australian manufacturers to try and break in on this market (perhaps they have and found it not worthwhile), but English companies appear to have very big sales. However, as I am engaged in the textile industry here I am not in a position to know the ins and outs of the radio trade here.

With all best wishes to your magazine and trusting I haven't wasted your time.

Yours faithfully,
James E. Healey.

AND FROM THE U.S.

I would like to correspond with other radio fans in Australia or anyone who is interested in radio as a hobby. I am mainly interested in crystal sets also in sets of one and two tubes. Could you please put me in touch with any one who would be willing to write to me and exchange hook-up ideas. I would also like to trade American radio magazines for radio magazines of Australia. Am also interested in stamp collecting and minerals. F. J. Kavaleski, PO Box 17, Franklin Mine, Mich., USA.

be under control and it should be possible to vary this condition by means of the regeneration control which varies the screen voltage to the detector. The most sensitive condition for the reception of signals is at a point just below oscillation. If the oscillation cannot be controlled with the screen voltage at a minimum the cathode tap on the coil should be moved closer to the earthed end. The circuit is a Hartley.

G.F.M. (Pymble, NSW) sends a poser for Answer Tom page concerning regenerative receivers.

A. We have passed your query on to the appropriate department, G.F.M., but, quite frankly, we are in some doubt as to the exact meaning of your query. Somehow you seem to have become a little tangled, particularly as regards the 50 cycle currents you quote. In the normal way the only 50 cycle current employed in a receiver is that used to replace the batteries in older type sets. However, it does not remain in this form for long, being converted to direct current by the rectifier and filter system in the receiver. From here on the only alternating currents are the RF signals received from the aerial and the audio signals present after detection

AN APOLOGY . . .

DESPITE our best efforts, we have found it completely impossible during the past few weeks to keep up with the demand for information through the postal query service. There have been difficulties, too, in securing sufficient reprints of our most popular circuits.

We can only apologise sincerely for any inconvenience that the delays may have caused but we must either accept the delays or consider cutting out the service altogether.

This we are loth to do, because it would rob us of a valuable contact with our readers and their problems.

J.G. (Toorak Vic.) asks our advice about a means of indicating the volume in a remote speaker.

A. Possibly the most straightforward solution to your problem would be to wire a meter in series with a multiplier resistance and rectifier across the speaker line. The multiplier resistance could be proportioned to give suitable deflections over the range of sound levels you require. In effect you would have a low range AC voltmeter. Unless you are academically minded, there is no need to go to the trouble of calibrating the instrument in absolute units. In most cases it would be sufficient to know that a particular reading on the scale represents a comfortable level. Your tone control circuit is in order, except that it may tend to be somewhat sudden towards one end of the range. Try a .05 mfd condenser, or lower value, instead of the .1 mfd condenser.

R.D. (Gladstone, NSW) requests the circuit of a receiver using 45's and 27's.

A. Sorry, but there is nothing in our files answering your description. In any case the performance of such a set would be so poor by modern standards as to be hardly worth the trouble of making. This is especially true as you are some distance from many of the stations you will want to hear. Glad to know that you enjoy the "Teach Yorself Radio" series.

B.M.B. (Rainworth, Qld.) forwards the circuit of a high fidelity tuner which uses a system of relays for selecting the stations. It is based on the high fidelity tuner recently described in Radio and Hobbies.

A. Many thanks for your letter and also the photographs of the tuner. It is possible that other readers would like to try the idea and we are filing your letter with the idea that it may make an item for the "Reader Built It" page at a later date.

FOR SALE. 3 SPEED RADIOGRAM (almost new)—Walnut-Veneered Cabinet —3 Speed B.S.R. Super-Silent Model T25 Motor, Spring mounted. Acos G.P.20 Pick-up for Microgroove Records. H.M.V. 12A Transcription Pick-up for Standard records. Radio and Hobbies Playmaster Amplifier No. 2 Design together with control unit. Finest quality Ferguson Transformers throughout. Magic-Eye tuning for Radio. Provision for Microphone. 12in Speaker. **Phone UM 6732, or call at 22 Burlington Road, Homebush.**

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5-valve — 8-valve

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LM5580.

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in one day by sending name and address for copy of my illustrated FREE BOOKLET, "How to Stop Smoking," with instructions what to do. Enclose name address and stamps for postage.

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Box 2444, G.P.O., Sydney.

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FOR SALE: 2 12in Garrard motor and P.U. £4/15/- each. 2 Torpedo Ribbon Mikes £4/15/- each. 2 reels, plastic magic-tape £2/5/- each. 1 Royce Junior traversing gear £3. **H. Smith, 189 Charles St., Footscray, Vic.**

SELL: Ferguson hi-fi OP transformer OP113. 5000 SE to 8 or 2 ohms, 65/-. Also Pyrox Zephyr crystal microphone with high quality insert 60/-. Both perfect, freight paid. **Blain, c/- ABC, Hobart.**

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RADIO TECHNICIAN wants you building your rig or rec 9/- per hour. Please write Bo **Guildford, NSW.**

COUNTRY READERS: I bet I that hard to find radio part **J. C. E. D'Alton, M/S 1652, Redcl**

A COURSE IN TELEVISION

(Continued from page 59)

vicinity of the TV set, as is usually the case with amateur transmitters, it may produce picture interference by overloading the TV receiver front-end and so produce local harmonics.

This, of course, is not the fault of the transmitter, be it amateur or commercial. It is merely a consequence of the close spacing between the transmitter and the receiver, and of certain deficiencies in the TV set front-end design.

Most receivers do not incorporate one or two high-pass filter sections between the antenna terminals and the first r.f. or mixer stage. This filter is intended to prevent the passage of strong, low-frequency signals into the tuner, but to accept the TV signals.

In many cases, where the TV antenna intercepts a very strong low-frequency signal, the built-in high-pass filter may not provide adequate attenuation to prevent interference of the "overloading" type.

It usually becomes the responsibility of the TV service technician to diagnose this trouble and to provide a cure. For this purpose several additional sections of high-pass filter may be necessary.

A typical design is detailed in Fig. 6. This filter is a balanced configuration for 300 ohm "twin-lead" and is of the double pi-section type. It is designed to have a high-pass cut-off at about 53 mc. so as to provide maximum attenuation to all amateur frequencies up to the 10 meter band (30 mc.).

The high-pass receiver filter should be constructed in a metal box similar to that described for the low-pass transmitter filter. Complete shielding is not too important in this case, since upshielded transmission line is used.

High quality components should be selected. The capacitors should be of the silvered mica variety. Two 10-micromicrofarad units may be used in parallel to form the required capacitance value and to minimize lead inductance.

THE COILS

The coils are close-wound on a three-sixteenth inch low-loss former and are centre-tapped by twisting a half-inch loop in the centre turn of each. These loops are then tinned and soldered to ground, leaving a quarter-inch lead.

All coils should be mounted at least one inch apart to avoid coupling.

Receiver interference of the "IF channel" type mentioned above will also be reduced by the high-pass filter if it is being picked up antenna. However, interfere both this type and the "ov ing" type may gain access receiver through the power by exposed wiring in the re

In such cases, a low-pas filter of the type shown in should be used. It may a necessary to improve the re shielding by adding a bottom p the chassis.

(By courtesy of the Aerovo poration).

OFF THE RECOR

(Continued from Page 83

In lighter vein, Capitol's n released Cole Porter Portrait collection of the composer's popular numbers played and corded in a smooth, easy-to style. This record should und edly command a good sale, and pares favorably with other C releases which have drifted overseas from time to time.

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